APRIL 21, 1958 PRICE 50 CENTS

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN
RESEARCH AND DEVELOPMENT

R ESEARCH
and news edition
D EVELOPMENT

JOSEPH AMANN
SAYS **YES!** PAGE 37

E. L. CHANDLER
SAYS **NO!** PAGE 36

COLLECTIVE BARGAINING?

THE SALESMAN

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R B POWER GS L
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NEWS ITEM No. 4 – 1958 – NEW PLANT IN STURGIS, MICHIGAN

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for April 28

FEATURING:

- **Guide to fan selection.**
  Charts, tables, sample problem and three laws to help you choose the right fan.

- **Casting alloy enters high-strength field.**
  Economy and fewer fabricating headaches are advantages offered by this special steel.

- **Sandwich-panel facing materials.**
  What materials are used as the skins of modern industrial sandwich structures.

- **Hermetic magnetic couplings.**
  Send power through a wall without worry about leaking shaft seals.

- **Metal inserts for plastic moldings.**
  The four broad types of inserts and how they can be used.

- **How to figure starting current**
  from NEMA code letters.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D Research and development news edition

April 21, 1958 Vol. 29, No. 16

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Product Engineering . . . . . SIDELIGHTS

R&D news edition — RESEARCH and DEVELOPMENT

- **Maintenance and repair** traditionally depend on chicken wire, chewing gum and a bigger hammer. Army Ordnance is making a try at eliminating some of the more rough and ready solutions (p. 21) and we wish them luck. But only last week the following list of supplies was inventoried in a major West Coast flight center–it reminds us of our own hall closet.

  Fingernail polish (for temporary identification symbols).
  Pipe cleaners (to clean out small-bore glass tubing).
  Fluorescent yarn (applied to plane exterior for airflow studies).
  Food coloring (mixed with water to simulate fuel dump tests).
  Potato starch, baking soda and salt (to make mold patterns, later removed by washing in water).
  Electric iron (just right for cement-backed plastic strain gages).

- **Never before in any technical publication,** the long-secret laws of research and development have at last been collated and organized for publication. These unwritten laws of experimentation, known as Finagle's Laws (p. 32) are the true foundations of all modern science. Why were they never before recorded? Researchers didn't dare admit even to each other, much less to the general public, how rare a successful experiment really is. But secrets cannot be kept forever. The public has a right to know. The shy, the timid, the weak, the optimistic are hereby warned. You read these laws at your own risk. PRODUCT ENGINEERING takes no responsibility for any cases of acute melancholia or hysteria induced by this article.

- **Controversy is the life blood of newspapers,** but technical publications (like the engineers they serve) usually try to avoid the dangerous arenas of opinion. We prefer scientific, demonstrable facts–unromantic perhaps, but safe. However, this week controversy runs wild in our pages. Editor and contributor disagree emphatically about whether salesmen should have anything to say about new products (p. 19 and p. 35) and there is much convincing logic in *both* points of view. The truth would seem to lie somewhere in between–if there is such a thing as objective truth.

  But what about the pros and cons of collective bargaining (p. 36)? Can there be a compromise in an issue that has no middle ground? And, in reality, do we choose an attitude based on logical reasoning–or do we choose first, emotionally, and then think up reasons to support our decision?

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READER TO EDITOR

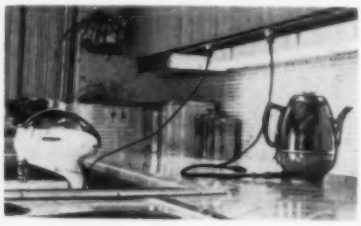
Numerous Electrical Outlets

To the Editor:

I read with interest the column "Why Don't They Research and Develop . . ." (Mar. 24, p. 50). One item in the column referred to, "why don't they have a metal or plastic molding to go along the ceiling or floor of a room—decorative in design and with enclosed wires to provide more numerous outlets and more convenience?" We introduced such a product, Electrostrip, to the American industry and public April 1, 1955. I am sure you will agree that BullDog deserves the title of being an inspired manufacturer. Electrostrip was 18 years in research and field testing prior to introduction. —PARKER STOUGH

BullDog Electric Products Co.
Detroit, Mich.

• *Here is what Electrostrip looks like in the kitchen.—Ed.*



Cooling Sleeves

To the Editor:

In a recent "Why Don't They R & D" column, a Mr. T. N. Tyler outlined the need for a flexible, resilient heat-conducting material.

We believe that our Metex resilient cooling sleeves fulfill this need and would be happy to supply additional information to interested engineers.

—C. P. SCHREIBER

Electronics Div., Metal Textile Corp.
Roselle, N. J.

Silicone Rubber Compounds

To the Editor:

In a recent issue, (Feb. 24, p. 50) Mr. J. Meyer asked in the "Why Don't They Research and Develop" column for ". . . a potting compound for encapsulating electrical assemblies. . . ." The problem he cites has already been solved.

Two new silicone rubber compounds recently announced by our department should meet all the requirements Mr. Meyer states and implies in his request. These RTV (Room Temperature Vulcanizing) materials are easy to handle, and provide the physical and electrical properties Mr. Meyer seeks.

We would be very happy to provide complete information and a sample to anyone wishing to experiment with the compound in their own laboratories. —JOHN J. WHELTON

Silicone Products Dept.,
General Electric Co.

Rolling Wheels

To the Editor:

With reference to Mr. Spence-Thomas's letter (Mar. 17, p. 24) I would like to mention that 30 years ago, at Karlsruhe Technische Hochschule in Germany, I used a compass to pencil or ink any one of 12 line patterns. It consisted of a wheel rolling along the surface of the drawing. Cam disks could be changed to produce various patterns, as selected.

—ERNEST J. HILLS

Westinghouse Electric Corp.

Upsidownen Halfentoner

Lieber Herr Tangermann:

Was ist mit das mixtenopp Halfentoner am Blatt 12 von Produktenschonen Engineeringsheit fur Marz 24? Das Deutscher Strassenlampe ist alles geflooey; ist bescheining vertikaloppen!

Am Fruhling in Berlin, sind die Volkswagenen beflying in Atmosphare? Oder ist alles die Weld Druber und Drunter?

—GEMUTLICHHEITLICH

Herr McDaniel

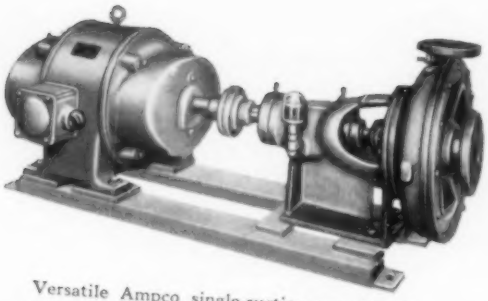
• *"Herr" McDaniel (of Westinghouse), who is as Irish as Paddy's pig, was the first of a number of sharp-eyed readers who caught the inverted cut of the German street lamp on page 12 of PE for Mar. 24. If you failed to catch it, don't be distressed—your copy may have been all right because the error was corrected part way through the run. For true Germans, here is a rough translation of Mr. McDaniel's note:*

"What is it with the mixed-up halftone on page 12 of PRODUCT ENGINEERING for March 24? The German street lamp is all geflooey; it's shining upwards!

"In Spring in Berlin, is the Volkswagen flying in the air? Or is everything in the world topsy-turvy?" —EIT

Production-built AMPCO® Pumps, FAFNIR-equipped, do job of costly "specials"

Interchangeable parts cut costs . . . provide unique pump versatility

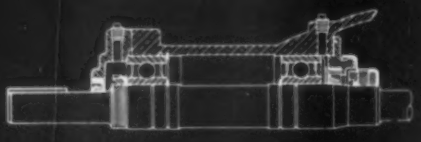


Versatile Ampco single-suction centrifugal pumps are available in sizes ranging from fractional flow to 600 gpm. They are particularly designed for corrosive or erosive fluids.

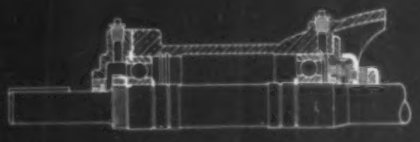
Centrifugal pumps manufactured with interchangeable parts by Ampco Metal, Inc., of Milwaukee are expressly designed to do jobs that would otherwise call for costly specials. They are also readily adaptable to new pumping requirements.

In designing this versatile pump series, Ampco needed various types of ball bearings. They found Fafnir had "all the answers" — bearings that met diverse size, load, speed, and lubrication requirements precisely.

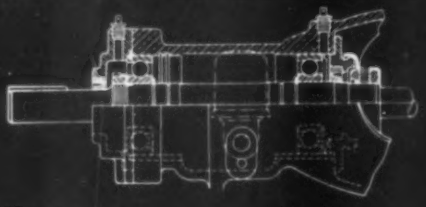
Chances are, "the most complete line of ball bearings in America" holds the answers to *your* bearing problems. Write The Fafnir Bearing Company, New Britain, Conn.



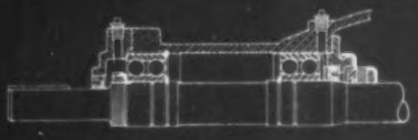
1 Wide type Plya-Seal ball bearings, prelubricated, single row, 200 light and 300 medium series.



2 Single row radial with snap ring, relubricatable, 200 light and 300 medium series.



3 Oil-lubricated, constant-level, single row with snap ring, 200 light and 300 medium series.



4 Double-row, oil or grease lubricatable, 5200 light and 5300 medium series.

TYPES OF FAFNIR BALL BEARINGS AVAILABLE IN AMPCO CENTRIFUGAL PUMPS

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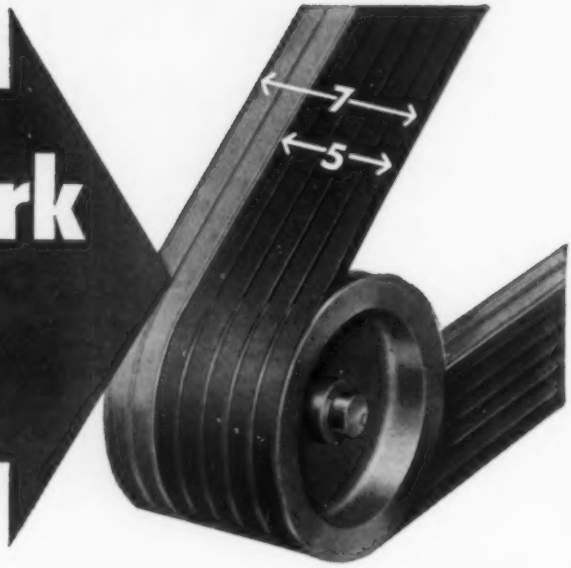
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

5 do the work of 7



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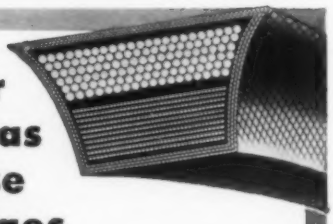
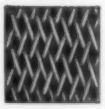
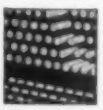




1. Flex-Weave Cover (U.S. Pat. 2519590)
A Gates exclusive: provides greater flexibility with far less stress on fabric. Cover wears longer . . . increases belt life . . .more power available to driven machine.

2. Concave Sidewalls (U.S. Pat. 1813698)
Concave sides (Fig. 1) increase belt life. As belt bends, concave sidewalls become straight, making uniform contact with sheave groove (Fig. 1A). Uniform contact means less wear on sides of belt . . . far longer belt life.



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TPA 209

Gates Super Vulco Rope Drives

40% more Horsepower Capacity

American...

DEVELOPMENTS TO WATCH...

Gasoline is the refrigerant . . .

. . . in a dashboard-mounted automobile refrigerator now being readied for market by Coldmaker Corp., 39 Broadway, New York 6. Says the company: The unit has no moving parts and there is no direct operating cost. It works by vaporization and recondensation of gasoline, drawn from and returned to the engine via the suction manifold. (Power for operation, of course, comes from the car's engine.) The passenger-car unit holds up to a dozen soft-drink bottles at a temperature of about 40 F, and will be priced at $89.50. A larger unit, for trucks and boats, will sell for $129.50.

Materials requirements for the next five years . . .

. . . as outlined by the Aircraft Industries Association, pose some tough R&D problems. Operating temperatures will reach 1200 F, says the AIA, and there will be a need for materials that can stand short-term exposure at least to 2000 F. At the same time, use of liquid propellants calls for structural materials able to stand minus 450 without flinching.

Even now, an AIA survey indicates an urgent need for adhesives that have a shear strength of at least 2000 psi after 200 hr at 600 F. There is also a strong demand for rubbery materials, insulating compounds, lubricants, hydraulic fluids, and coatings with the same temperature range, plus ability to stand corrosive chemicals, hydraulic fluids and nuclear radiation.

Where are such materials coming from? Relatively conventional materials should be able to meet immediate needs in most cases, if full advantage is taken of new developments. For instance, petroleum-based oils and greases should be serviceable to 1000 F (*PE*—Dec 9, '57, p 9). Then, dry lubricants could take over for the 1000-to-1500-F range. Above that, vapor-phase lubrication will probably have to be used. For the long term, though, the AIA is pinning its hopes on ceramics, particularly for structural members; and flame-plated and fused metallic coatings.

"Impossible" welds in thin-gage stainless . . .

. . . and titanium—are solving design as well as production problems at Convair's Fort Worth plant by joining narrow sheets to provide wide ones needed for new-type aircraft. Using a high-stability helium-shielded tungsten arc, a special holding fixture (see photograph), and a gas backup (for controlled cooling), Convair has made flange-type joints in 17-7 stainless sheet only 0.002 in. thick on an experimental basis, and is turning out welded 0.005-in. sheet on a production basis. Here, the welding-bead reinforcement is held to minus 0.001 and plus 0.003 in. for the full 72-in. length of the skin sections being produced, and retaining the 1.1% aluminum content. On titanium of slightly heavier gage, the company is securing good results with both commercially pure and alloyed metal.

The backup bar itself posed an interesting design problem. Both the material of which it is made (Mallory No. 3 copper was chosen) and the geometry of the groove (rectangular grooves proved superior to square or circular ones) directly affect weld quality.

Special welding setup turns narrow sheets into wide ones. Top—work in progress; below—sample weld.

American...

(continued)

DEVELOPMENTS TO WATCH...

Another miniature battery . . .

. . . this one fully sealed and rechargeable, is now ready for commercial test. Made by P. R. Mallory Co., 60 Elm Street, North Tarrytown, N. Y., it is less than 1.2 in. in diameter and about ½ in. high, yet has a rated capacity of 2000 ma-hr, will deliver a flash current of 1.2 amp, and will discharge continuously at 125 ma. It's a 1.35-v mercury cell that weighs 1½ oz, has a development price of $2 to $4. (For more information on this tiny titan, and on other midget batteries, see *PE*—May 12, '58.)

Heat of friction is put to work . . .

. . . in a new wood-finishing process that might be a thought-starter for other types of finishing machines. Developed by General Plywood Corp. and Reichhold Chemicals, Inc., the process is designed to put a smooth, plastic finish on wood surfaces; but, instead of the usual coating method, it uses pressure and friction to create heat which melts the natural lignin resins in the wood so they combine with the plastic applied to its surface, forming an integral finish. This "Super Microseal" finish, the companies say is actually a part of the wood, not a film or overlay; and it can be produced at rates as high as 120 linear ft a min on almost any type of wood.

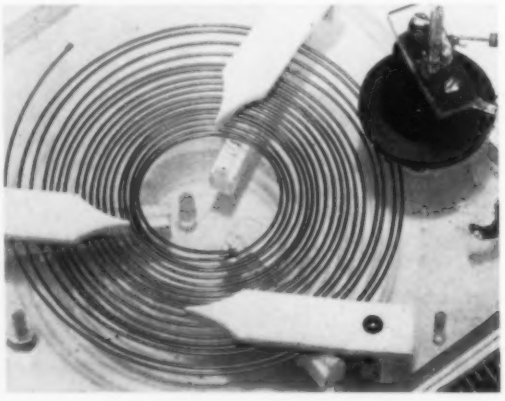
In the prototype finishing unit, a nonabrasive belt, installed in a machine resembling a power sander, rubs against the wood, creating enough heat to melt the lignin in about 0.05 sec. Then, the synthetic resin (including penetrants and a catalyst) is applied by a roller-coater, and the wood is dried. Two more passes through belt machines set the resin and complete the chemical reaction, and the material is ready for shipment and use.

New heavy-metal alloy . . .

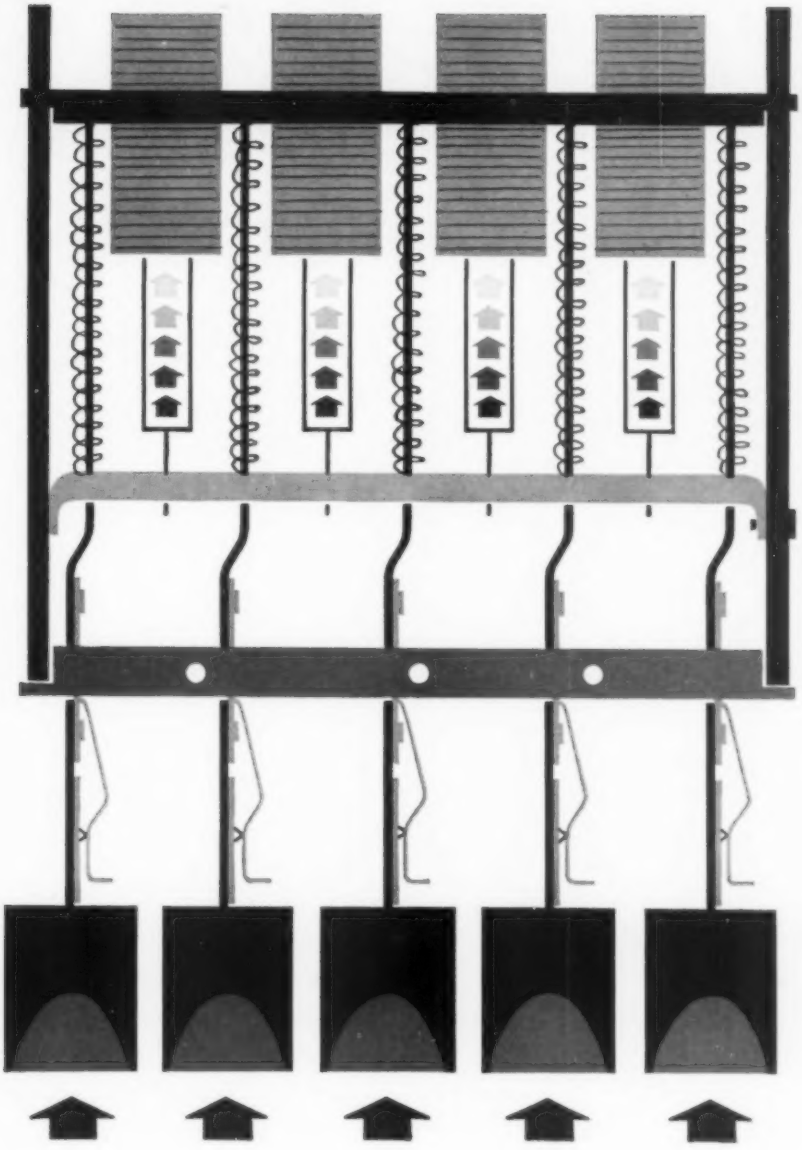
. . . now being evaluated for use in rotors, counterweights, and radiation shielding promises to be a 15% improvement over the standard heavy metal, Fansteel Metallurgical Co. reports. The new alloy, which Fansteel has tentatively labeled "Fansteel 99" (its standard alloy is Fansteel 77), is described as "almost pure tungsten, but containing additions that give it machinability and the ability to be compacted." It is heavier than the standard material (density is 18.4, compared with 16.7); and its mechanical properties appear to be good, but Fansteel cautions that its tensile strength has not yet been fully tested. (In forthcoming issues, PE will present a detailed discussion of heavy metal—and tell of an interesting new entry in the field that promises to solve tough design problems.

Delay line for trigger circuits . . .

. . . computer "memories" and electronic switching, that "packs a long delay in a small space" has been designed by Bell Labs engineers. Called a *spiral coiled-wire torsional-wave delay line*, it "permits the clear resolution of 10 microsec pulses spaced 20 microsec apart." In one experimental line, Bell Labs says, a 15-ft length of wire, coiled into a spiral about 4 in. in dia (see photograph), exhibited a delay of 1.65 millisec at 840 kc. Wire is BTL-developed, low-loss vibralloy, 0.038 in. in dia.



Torsional delay line uses coiled ferromagnetic wire, has special ceramic transducers (at wire tips) to inject and detect torsional waves. —ARG



The illustration details the principal action of pushbutton radio tuner. Though each pushbutton travels the same distance "in", each positions the cores differently in relation to the tuning coils.

you call the move . . . we'll make the motion

Go right ahead, call the *move!* . . . up, down, over, under, around, right, left, in, out, one at a time, all at once . . . we'll make the *motion*, the whole motion. Your *move* will be designed and manufactured as a complete actuating package, fully tested and operation proved.

Radio Condenser *Custom-Made* Electromechanical Assemblies offer *programmed motion at a touch*. In the fast-growing field of pushbutton dynamics, for example, R/C assemblies can make a finger do most anything . . . tune a radio, "switch" TV channels, do the wash, shift gears, cook breakfast . . . you name it!

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CONTROLS DIVISION

R/C RADIO CONDENSER COMPANY CAMDEN 3, NEW JERSEY

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resistance to shock and overloading

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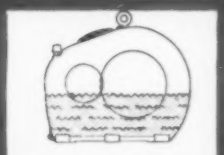
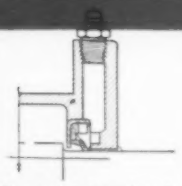
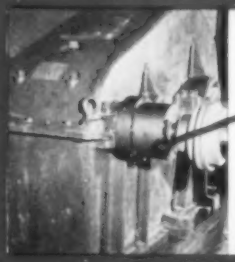
Write for your copy of Book 2619 on this broad line with ratios to more than 300:1. Or get first-hand information from your nearest Link-Belt office.



Automatic splash lubrication reliably supplies oil to all gears and bearings.



Grease-lubricated seals on all input and output shafts prevent entrance of dirt, water.



Backstop automatically prevents reverse rotation of output shaft due to power stoppage or other causes.

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DEVELOPMENTS TO WATCH...

A real shake-up . . .

. . . of the present military way of doing business is what Eisenhower wants. That's completely clear from the sweeping reorganization proposals he has submitted to Congress. If he gets anything like what he has asked for, the Pentagon would be in for the biggest change since the end of World War II.

The shake-up would be right across the board—taking money from those who have been in charge and giving it to other officials, giving the Secretary of Defense many more powers than he has ever had over the service secretaries, building up a Joint Chiefs of Staff that would become even more important in both plans and operations, create in effect another branch of the service for research and development, and take away from the service much of the power they have had to select their own top officers.

The real object of the proposed reorganization is to beef up authority of the Secretary of Defense (who up to now has sort of presided over a confederation of powerful service chiefs) and the Joint Chiefs of Staff (who up to now have been the focal point for plans but have not had as much to say about actual command of forces as the service chiefs).

The secretaries of the Army, Navy, and Air Force are the ones who would be left out on a limb, with vastly weakened power and prestige.

A new R & D agency . . .

. . . would be created under Eisenhower's plan. Its head would be "Director of Defense Research and Engineering", and he would be in complete charge of all R & D planning and have supervision of all R & D projects including missiles and space projects.

In effect, such an agency would become a fourth military department. Its chief would report directly to the Secretary of Defense, with no other echelon of authority in between. His agency would be the recipient of all the R & D funds appropriated by Congress to the military (now amounting to about $2-billion a year), and he would be the one to allocate funds to different projects at the hundreds of R & D facilities that now belong either to the Army, Navy or Air Force.

As things are now, each service has its own R & D program. Each reports to an assistant Secretary of Defense for R & D (today Paul Foote) who really has only the power to "co-ordinate" their efforts.

Already one big step is being taken, of course, in the direction Eisenhower proposes to go with his sweeping re-organization. That's the earlier creation of the "advanced research projects agency", which is now headed by ex-GE vice president Roy Johnson, who now has the responsibility for all Pentagon space projects.

The power to promote . . .

. . . to the top command ranks would effectively be taken away from the top officers of each of the services. There's no doubt that Admiral Burke, for instance, was the selection of the Navy brass, and General Twining the choice of the Air Force. Only in the most extraordinary circumstances would either the Secretary of Defense or the President step in and say "no;" however, right now, only the chairmanship of the Joint Chiefs is a Secretary of Defense-White House selection all the way.

What Eisenhower wants is authority for him and his Secretary of Defense to promote any officer to Lt. General or Vice Admiral. The object: to guarantee "team play" and cut the service-connected ties.

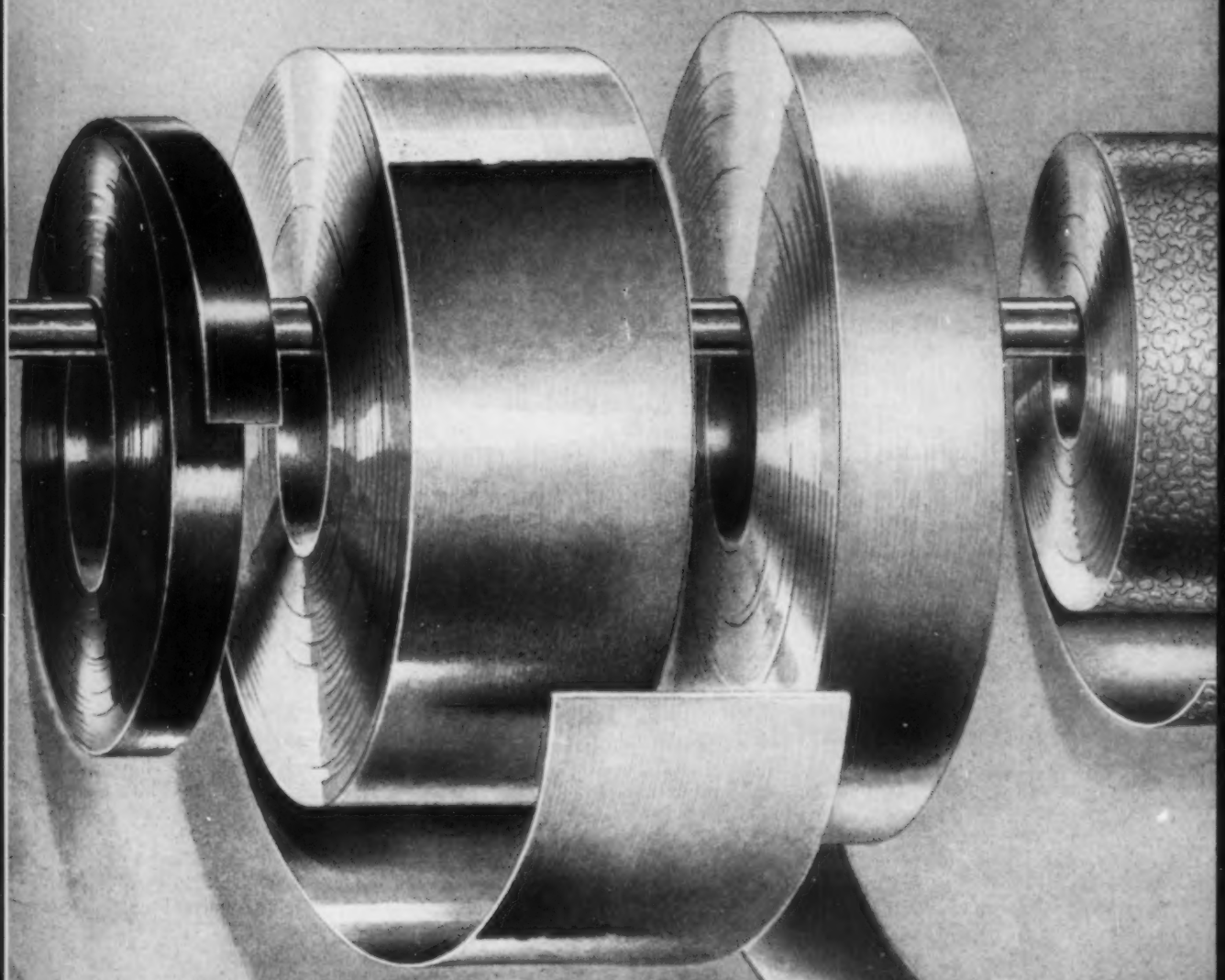
Congress will object . . .

. . . to most of what Eisenhower is proposing. The key men—chairmen of the Armed Services Committees and Appropriations Committees of the House and Senate—like the present set-up very much. The present organization benefits both these legislators and the military officers to whom they vote authority for projects and the money to carry them out.

The build-up of the role of the Secretary of Defense and the Joint Chiefs in effect down-grades, too, the extent to which the congressmen can get at the details of military functions and the military's spending of money.

Already, there's speculation that Eisenhower may get nothing at all from Congress this year. But he is trying to put some parts into effect without waiting for legislation.

SHARON..



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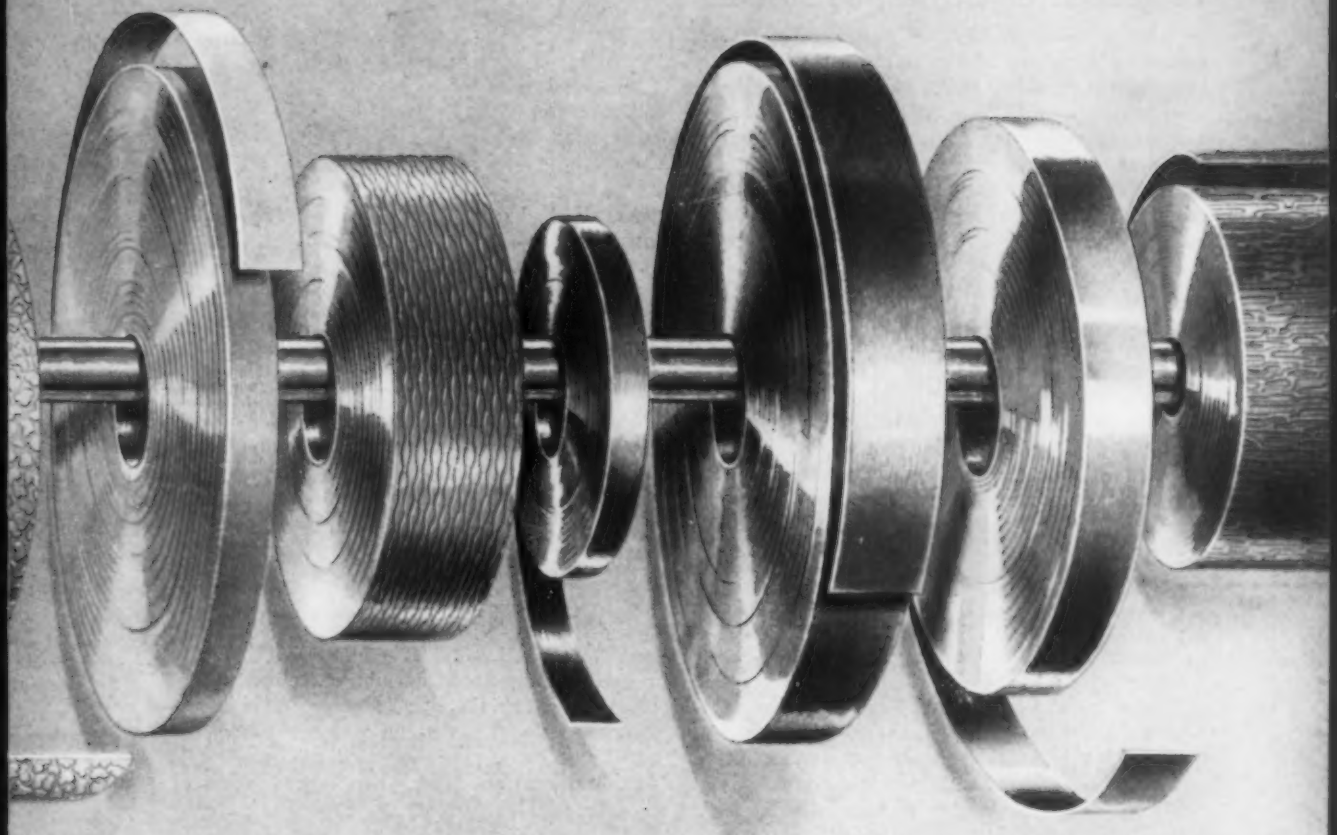

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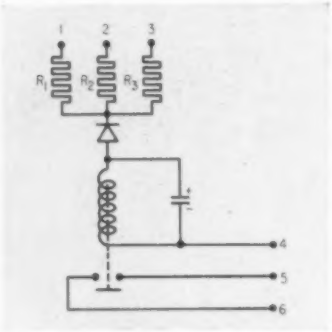
DEVELOPMENTS TO WATCH...

To ground electrical equipment . . .

. . . and eliminate the hazards that might occur when the regular grounding is corroded or disconnected, an Italian engineer has devised and patented the safety system pictured here. It consists of a detector incorporating a dc relay, a rectifier, and three resistors (R_1, R_2, R_3); and a visual or acoustic alarm unit. When a single, fully insulated appliance or machine is connected to it, the inventor says, it is enough to connect terminal 4 to the metal housing. Terminals 5 and 6 then connect to the alarm unit. If several appliances are connected in parallel, though, a small resistance is inserted between terminal 4 and the grounding system to block out stray voltages from other equipment and to prevent "false alarms."



A 3-D drawing board . . .

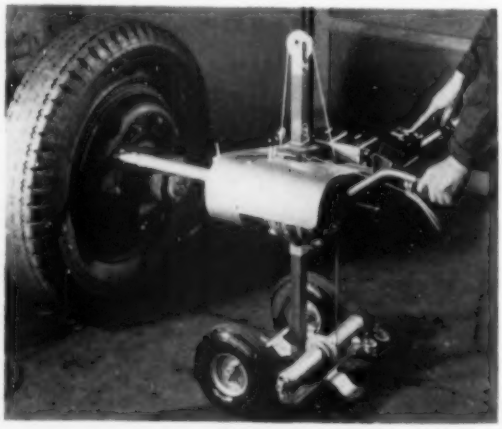
. . . has been developed by Mavitta Drafting Machines, Ltd. of Warwickshire, England, specifically to aid the skilled draftsman to work more rapidly and accurately, though "it can be used by anyone." Main features of the board are three intersecting lines, marked in units that diminish "in accordance with the rules of perspective," and three transparent T-squares that slide along the arc-shaped sides of the board to form straight edges. The board, priced at $56, fits over any standard drawing board.

Automatic tool-breakage detector . . .

. . . is designed to shut down machine tools—particularly transfer machines—when breakage occurs. It consists of small molded-in-plastic coil that fits around the tool itself, connected by cable to transistorized printed-circuit alarm units that plug into sockets mounted in the machine's own control box. Two detector coils cover the full range of tool sizes from No. 60 drill to ¾ in. The unit is said to be able to operate satisfactorily at ambient temperatures to 100F and under voltage fluctuations as wide as plus to minus 10%. The detector is designed for operation by a 12-v dc power supply at 100 ma. It was developed by Airmec Ltd., High Wycombe, Bucks, England.

Pushbutton maintenance . . .

. . . is the aim of the West German firm that developed the tire-changing device pictured here. It looks like a Rube Goldberg, but Nanno Th. Collman & Co., Moislinger Allee 222, Luebeck, says it operates quickly and efficiently under control of the push buttons mounted on the right handle. The unit has a 1.1-hp motor arranged to drive the device in either direction, so it can be used for installing as well as removing tires; and, the company says, it's versatile enough to be adaptable to other maintenance uses.



For truck and auto servicing a West German firm offers this mobile, motorized, pushbutton tire-changing device.

NEW FROM Saginaw

PHOTOGRAPHED ACTUAL SIZE
BALL CIRCLE DIAMETER: only 3/16 inch

SMALLEST ball/bearing SCREW OFFERS BIGGEST ANSWER TO CRITICAL POSITIONING/CONTROL PROBLEMS

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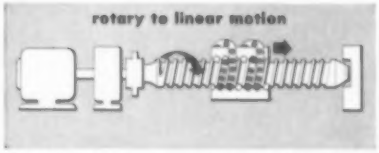
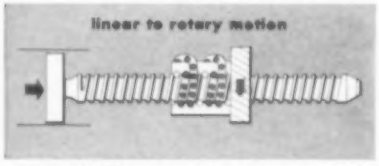
These amazing little fellows are so compact and weigh so little—you can save greatly on space and weight. So efficient—over 90%—you can use much smaller motors and gear boxes. So precise—you can position components within .0005 inch per inch of travel. (If application requires, lash can be eliminated.) So dependable—you can rely on remarkably long service life even in extremely adverse environments.

Every day Saginaw's experienced engineers are helping more and more forward-looking manufacturers to gain these advantages of Saginaw Miniature b/b Screws. Let them help you plan your application. No obligation. Simply phone, write or mail the convenient coupon below.



NUT TRAVELS: When rotary motion is applied to the screw, the b/b nut glides along the axis of the screw on rolling steel balls, converting rotary force and motion to linear force and motion with 4/5 less torque than acme screws.



SCREW TRAVELS: When rotary motion is applied to the b/b nut, the screw glides along its longitudinal axis on rolling steel balls, converting rotary force and motion to linear force and motion with unprecedented efficiency.

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What's happening in SCIENCE

Low-frequency whistles for high-powered jobs

Do you know the difference between a plain whistler and a nose whistler? If you encountered a sferic, would you pick it up, salute it, or use it to study the upper atmosphere?

Most people today wouldn't know. But, by the time 1958 is over, whistlers and sferics may be quite familiar. They represent an important area of IGY research. It's basic research that may not have "practical" value until long after the IGY has ended. But it is giving researchers a new tool for space studies—and it may pave the way for new radio-transmission techniques.

Whistlers, as IGY scientists explain them, are naturally occurring audio-frequency radio waves that, when converted into sound, can be heard as long whistles. Ordinarily, they're descending whistles. But, recently, ascending ones have been detected, the National Academy of Sciences reports.

Whistlers are by no means new. They were recognized back in 1886. What is new is the theory developed to explain them, and the use to which they may be put. It is now believed the the ionosphere (the upper atmosphere in the 30 to 250-mi-range) acts as a selective dispersion medium for radio waves. Lower frequencies are transmitted through it at ever-lower rates. Observing the paths of the low-frequency whistler waves and the dispersion that occurs, can therefore tell a good deal about the ionosphere itself.

Under certain conditions, the propagation velocity of a whistler seems to reach a maximum and then decrease, even though frequency may continue to increase. This creates a double or "nose" whistler, which has both rising and falling components. Furthermore, the shape of the nose whistler seems to be related to the intensity of the earth's field along the whistler path and the amount of ionization it encounters. That's a tip-off to the character of the upper atmosphere through which it travels.

And what are sferics? They're a special kind of whistler—high-energy, low-frequency radio waves (generally below 10 keps) arising from naturally occurring electric discharges such as lightning. The fact that lightning can produce them (though it does not always do so) adds to their special interest.

Novel design for atomic power

A thermoelectric device for converting nuclear energy into electricity, being developed by Siemens-Schuckert-Werke, Erlangen, Germany, combines structural, fuel, and electrical elements in an interesting way:

According to the company's preliminary patent application, the carriers for the thermocouple elements used in the device would do double or triple duty. They can serve as moderators and fuel rods for the reactor in which they are used, and might also pipe cooling liquids and gases through the reactor. In one design, fuel would be placed between thermocouple contacts, and graphite, bismuth, and beryllium alloys used in the element carriers would serve as moderators. In another design, uranium or thorium fuel, too, would be fabricated into hollow rods in which the thermocouple elements would be inserted.

Conventional lines of atomic research, as well as the new ideas outlined above, are being pursued in West Germany. Photo here shows new 50-kw solution-type reactor built by Atomics International and now in operation at Max Planck Institute of Physics, Frankfurt.

Filling up for a moon trip

How much fuel would it take to get to the moon?

If you're not in too much of a hurry, the amount would not be unreasonable, David B. Langmuir told the U. of California's Space Technology Seminar. A trip to the moon and back, assuming a velocity of about 30,000 ft/sec when the vehicle left the earth's gravitational field, and using a power system with a specific density of about 10 kg/kw (comparable to conventional turbines and generators) would take about 4 mo and would require only 0.99 megawatt-days of electrical power. That could be supplied by about 88,000 lb of chemical fuel and oxidant.

Using solar power, though, the trip would take longer—about a year—because present solar-battery systems would weigh about 30 kg/kw. Estimated cost: about $50,000 to $100,000/kw at present prices.

Atom-smashers by the mile

An electron-accelerator two miles long? Dr. Leonard Schiff of Stanford U. proposed it to a Congressional Committee—and he isn't kidding. Pointing out that the energy of the electrons produced by a linear accelerator is directly proportional to its length, he notes that a linear accelerator two mi long (roughly 50 times as long as the one now installed at Stanford) would produce electrons of about 50 times the energy—25 to 45 bev. Surprisingly, he anticipates no difficulty in aiming the electron beam over a distance that long, or in obtaining the necessary power. About 1000 klystrons should do the trick.

Stanford has already done a good deal of preliminary work on this problem, which it has labeled "Project M," and has even calculated the shielding that would be required. The necessary real estate is available, too.

—ARG

Polyethylene: better, and maybe cheaper

New linear polyethylenes are coming from all directions:

Bakelite has just brought its first big (30-million-lb) plant on stream; expects to have another (25-million-lb) onstream within 6 months.

Phillips Chemical Co., already producing the material in quantity, has a new extrusion grade that is said to have the stiffness, heat resistance and hardness of the earlier types, but with an impact strength and resistance to environmental stress cracking 3 to 4 times as great. This resin (Marlex Type 2) will be available at the standard price (now 43¢/lb).

Linear polyethylene's price may be coming down even further: Allied Chemical claims it has a new low-pressure technique that "would require a much smaller capital outlay than other processes," and can produce tough, high-density linear polyethylene that should be suitable for use in molded articles as well as film and sheeting.

Better rubber heads for market

For complex electrical moldings and extrusions, elastic thread, and such applications as food machinery parts, "requiring a high degree of chemical cleanliness," natural-rubber producers are readying a new grade of rubber, *SP* air-dried sheet, that promises improved processing characteristics, greater purity, reduced distortion, improved surface finish, and lower unit cost.

Originally introduced in the form of high-grade crepe, SP rubber (the initials stand for "superior processing") is a mixture of vulcanized with field latex, in the approximate ratio of 1:4. The combination is said to be more stable than ordinary rubber in both processing and storage, and to resist water-marking. The air-dried sheet, less expensive than crepe, and suitable for use where very light color is not a primary consideration, is now in pilot production, and should soon be commercially available.

A bulletin describing SP rubber may be obtained from the Natural Rubber Bureau, 1631 K St., N.W., Washington 6, D. C.

Our own glossary

I-Guide to fluorine plastics

So many new plastics are coming along, it's hard to keep up with them. Here, then, is our own brief guide to generic terms and trademarks for one important group—the fluorocarbons. Others will follow.

GENERIC TERMS:

TFE-fluorocarbon resin: fluorinated hydrocarbons; chemically, tetrafluoroethylene.

FEP-fluorocarbon resin: fully fluorinated (perfluorocarbon resin); chemically, fluorinated ethylene propylene.

Both of these resins have unusual chemical and heat resistance, a low coefficient of friction and a low dielectric current; but the TFE resins can be used continuously at higher temperatures, have greater flex life than the FEP; while the latter are more easily molded and extruded.

CTFE resin: partially fluorinated hydrocarbon, similar to TFE and FEP resins, but having slightly lower heat and chemical resistance; while offering advantages in hardness, transparency and other respects. Chemical name: chlorotrifluoroethylene. Also known as fluorothene.

Trade names used by major producers:

Teflon: DuPont TFE resin

Teflon 100-*X:* DuPont FEP resin

Kel-F: Minnesota Mining CTFE resin

Viton: DuPont fluorocarbon rubber

Now it's stainless sprayers

There's a new contender in the spray-bottle field, and it signals solution of a tough design and fabrication problem. The "bottle" is a stainless steel cylinder $1\frac{3}{8}$ in. in dia and $2\frac{1}{2}$ in. long. Drawing a cup as narrow and deep as that is no simple job. But current production at the rate of 10,000 a day—prove it can be done.

Production starts with a 3-in. blank, 0.010 in. thick. It is formed in an 11-stage transfer press (six of the stages are for drawing operations). Allegheny Ludlum Type 350 steel is used. The valve stem is also a drawn part—starting from a blank 39/64 in. dia. Both parts are formed without any intermediate heat treatment.

briefs . . .

Boost for columbium, one of the most promising of the "newer" metals (*PE*—Mar 17, '58, p. 56) comes in the form of a report by Battelle Memorial Institute to the Atomic Energy Commission. Low neutron absorption, high strength at high temperatures, corrosion resistance under nonoxidizing conditions, and fabricability make the metal (also known as niobium) attractive for nuclear use—particularly since supply now seems able to keep up with demand. On the other hand, high cost (especially for metal destined for nuclear applications) and low oxidation resistance are hurdles that will have to be overcome. On the latter score, both additives and alloying have shown promise. Copies of the report, *Niobium Technology* (Nuclear Technology Briefs No. TI-3, part I) may be obtained from Division of Information Services, US Atomic Energy Commission, Washington 25, D. C.

Abundant earths should be the name for the "rare earth" metals in the future. Never as rare as they were once thought to be, these active elements are scheduled for still another boost when the recently announced merger plans of Lindsay Chemical and American Potash go through. Lindsay is already a leading producer of rare earths and their compounds; American Potash has been a supplier of three related metals: lithium, rubidium, and cesium. —ARG

Miracle Plant! Zoospores of some fungus cover their own length as fast as a Sabrejet. The bacterium *Pseudomonas aeruginosa* (shown many times its size) has been clocked at 31.7 lengths per second. To do as well, proportionate to size, a man would have to run 125 miles an hour.

Miracle Instrument. This anemometer catches a puff of wind wafting less than 1 mile per hour. Its high sensitivity and accurate measurement of wind speed are aided by two MPB bearings in which the shaft rests. Quick starting is result of low initial torque.

Man With Miracles. This is Nick Carter, MPB's Chief Engineer. He helped the anemometer people find exactly the right type of radial retainer bearing that would reduce friction to a minimum, give failure-proof service and help keep original and maintenance costs low.

Miracles in Miniaturization

ACTUAL SIZE

New Age Of Miracles is miniaturization in industry. It's a new frontier as magnificent as the colossal. With MPB bearings the impossible miniaturization often becomes practical; the pretty-good becomes perfect. MPB has the greatest wealth of experience in miniaturization in the bearing industry . . . over 500 types and sizes available . . . specials on request . . technical assistance and research facilities second to none. You'll want to know more about the subject. For our new catalog write **Miniature Precision Bearings, Inc.,** 204 Precision Park, Keene, N. H.

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Helps you perform miracles in miniaturization

THE DESIGNING PEDDLER

Every engineer is familiar with the salesman and his habit of selling promises which others must keep. The salesman—elastic expense account, large income (in good times), hearty optimist with the booming voice, admitted innocent in engineering (or so he insists).

Actually, the salesman is a major factor in engineering development. He brings back the attitude of the customer, insists on "sales features" and styling, is quick to pick up competitors' advances, even senses buyer needs or potential needs. These, unpopular though they may be at any given time, are valuable information to the designer.

But, beyond that, the salesman is frequently an even more-potent force. He it is who sells blue sky, tomorrow's designs—who builds in the potential buyers' minds the belief that "his" engineers can design anything. Thus he forces them, willy-nilly, beyond the accepted parameters into new fields.

Examples are legion. There is one story of a salesman who sold a citrus-juice processor a control system that didn't exist—for maintaining the specific gravity of juice—because he innocently assumed that a system for measuring specific gravity could be modified to control it. After the dust cleared away, the engineers buckled down and did it, opening a new field for the company.

Then there was the salesman who sold a steam turbine for far higher pressure and temperature than could be attained with available metals. New metals and processes had to be developed, but it was done, and in time to win premium payments rather than penalties.

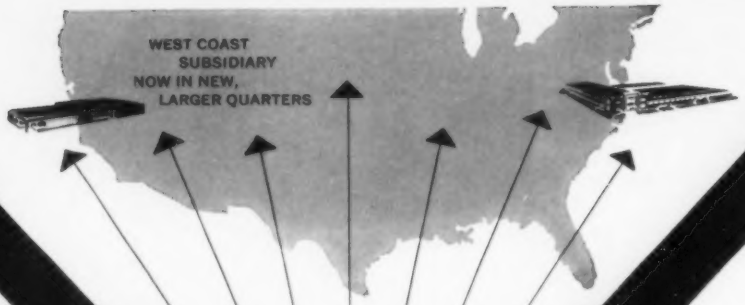
You know of other examples, probably have been involved in some. There's plenty of cussing and fussing about the salesman who does such a thing, plenty of remarks about "the fool who doesn't know any better."

Doesn't he? Isn't he often just testing your mettle, just forcing you to show other people how good you are? Isn't he pushing the parameters out just a little? Isn't he, in his "educated ignorance," sometimes supplying necessary vision? If we can be permitted to parody a verse of Edgar Guest's, as so many have done:

He brought the specs in, with the trace of a grin,
If he was worried, he hid it.
He brought us the job that couldn't be done—
And, by golly, we did it!

L. S. Langerman

This editorial was written in Dallas. At the same time, Mr. Sharpe's article on page 35, presenting the diametrically opposed view, was received in New York. We give you both in one issue, to show—again—that there are two sides to every question.



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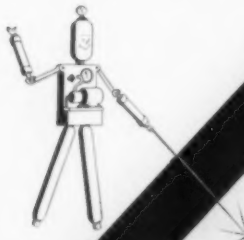

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R&D Spending Soars Despite Recession

McGraw-Hill Dept. of Economics Survey Shows the Industry will Pump $8.3-billion into Research this year

NEW YORK—Spending for research and development is riding a sharply ascending curve in American industry. A survey just released by the McGraw-Hill Department of Economics reports that business firms will pump $8.3 billion into R&D this year—a 14% gain over last year's $7.3 billion. Queried on future plans, US firms already say they plan to budget $9.9 billion for research in 1961. These plans are preliminary. However, in the past, advance estimates have generally proved conservative.

A large part of the $1 billion increase in R&D for 1958 results from increasing national-defense requirements. In fact, the most significant change from a preliminary survey made last fall (PE, Nov. 18, p. 25) is a sharp increase (36%) in research for the aircraft industry. At that time aircraft makers planned no increase, or in some cases cuts, in expenditures. But even without an increase in military research the over-all trend is impressive.

Growth of R & D Expenditures

(Millions of Dollars)

	Planned		
	1957	1958	1961
Primary metals	$119.4	$124.2	$154.0
Machinery	582.1	611.1	672.3
Elec. Eq.	1367.2	1490.2	1862.8
Aircraft	2336.7	3177.9	3845.3
Fab. metals & ord	193.3	206.8	248.2
Prof. & Sci. Inst	295.0	271.4	252.4
Chemicals	567.5	595.9	685.3
Paper prod	48.4	50.8	57.9
Rubber prod	76.0	77.5	93.0
Stone, Clay & Glass	63.8	67.6	83.1
Petrol. Prod	231.4	245.3	294.4
Food prod	86.6	95.3	114.4
Textiles & apparel	35.8	38.7	43.7
Other Mfg.*	931.9	894.6	1055.6
ALL MFG	6935.1	7947.4	9462.4
Nonmfg	346.0	348.1	388.0
ALL INDUSTRY	7281.1	8295.5	9850.4

* Includes autos, tobacco, lumber & wood products, furniture, printing & publishing, transportation equipment other than aircraft and autos, and miscellaneous industries.

The sharp jump in R&D is particularly significant, coming as it does at a time when business is trimming expenses in many other areas. The McGraw-Hill report illuminates business plans and expectations in other vital areas of corporate activity. These statistics show that:

- Manufacturing industries will spend $11.1 billion on new plant and equipment this year—an 18% drop from last year's $13.6 billion.
- Industrial plant was operating at 78% of capacity at the end of last year, compared with 92% of capacity at the close of boom year 1955.
- Manufacturers expect the physical volume of their sales this year to slide 2% under last year's level.

NEW PRODUCT PLANNING

New technology is the key to industry's plans for increasing sales. By 1961, industry expects its physical sales volume to increase 20% over 1958 levels. With conventional markets growing more slowly, the myriad of new products expected by 1961 will be crucial to expanded sales. For manufacturing as a whole, 12% of 1961 sales are anticipated in products that either were not produced this year or will be so fundamentally altered that they will really be new. On the preliminary survey last fall, manufacturers indicated that 10% of sales in 1960 would be in new products.

Product innovation will be especially pronounced in the transportation equipment industry (42% of 1961 sales) and the machinery industry (22% of 1961 sales.) Other industries anticipating that at least 10% of sales will be in new products are chemicals, 14%; autos, 12%; pulp and paper products, 10%; stone, clay, and glass, 10%; and textiles, 10%.

Most companies expect present research to pay off heavily over the next five years. When asked how soon they expect benefits from current R&D investment, 39% of the companies foresaw returns within three years. An even heavier concentration of companies, 52%, expect returns in three to five years. The remaining 9% of the companies, primarily those who emphasize basic research, expect return on their investment to take six years or longer.

How Soon Do You Expect R&D Expenditures to Pay Off?

	Per Cent of Companies Answering		
	Less Than 3 years	3 to 5 years	6 years and over
Iron & steel	50%	50%	0%
Nonferrous metals	42	42	16
Machinery	49	45	6
Elec. mach	23	69	8
Autos, trucks	40	60	0
Transp. Eq.*	24	65	11
Other Metalwk	24	71	5
Chemicals	15	56	29
Paper & pulp	25	69	6
Rubber	50	17	33
Stone, Clay, Glass	44	50	6
Petroleum ref	12	63	25
Food, bev	37	54	9
Textiles	65	29	6
Misc. mfg	66	31	3
ALL MFG	39	52	9

* Includes aircraft, ships, RR equipment.

A significant share of industrial R&D will lead to improved products rather than new products and processes. Asked to specify the main purpose of their research programs, 41% of the companies indicated product

How Much of 1961 Sales Will Be in New Products?

	New Products# % of Sales
Iron & steel	5%
Nonferrous metals	4
Machinery	22
Elec. mach	8
Autos, trucks & parts	12
Transp. eq.*	42
Other metalworking	13
Chemicals	14
Paper & pulp	10
Rubber	8
Stone, clay, glass	10
Petroleum refining	4
Food, beverages	5
Textiles	10
Misc. Mfg	9
ALL MANUFACTURING	12

Defined as products "not produced in 1957 or products sufficiently changed to be reasonably considered as new products."
* Includes aircraft, ships, RR equipment.

What Is the Purpose of Your Research Program?

	Per Cent of Companies Answering		
	New Products	New Processes	Improved Products
Iron & steel	27%	27%	46%
Nonferrous metals	64	27	9
Machinery	51	3	46
Elec. mach	68	0	32
Autos, trucks	50	8	42
Transp. eq.*	56	5	39
Other metalwk	37	13	50
Chemicals	67	6	27
Paper & pulp	37	13	50
Rubber	50	17	33
Stone, clay, glass	42	10	48
Petroleum Ref	29	42	29
Food, bev	53	19	28
Textiles	37	16	47
Misc. mfg	33	18	49
ALL MFG	48	11	41

* Includes aircraft, ships, RR equipment

improvement, 48% new products and 11% new processes.

EXTENT OF R&D VARIES

But there are wide variations in this pattern between industries. Process development is relatively insignificant in the metalworking industries, but accounts for 42% of research in petroleum refining, and a substantial portion of research in basic industries as nonferrous metals and iron and steel. In such industries as electrical machinery, machinery, chemicals, autos and aircraft, more than 90% of companies specified product improvement and new product development as the main purpose of their research.

The McGraw-Hill survey is based on replies to questionnaires received in March and reflects industry thinking at that time. Companies participating in the survey are generally the larger ones in their industry and employ about 40% of all industrial workers.

The research boom holds promise for capital spending in future years. The impact of research on current plans for new capital equipment is very gradual. But the number of companies who are building or adapting facilities for making new products has been growing significantly in last few years—the total is now near 60%. And it is already clear that research is becoming a significant force in market development—both of completely new products and of improved quality of existing products.

Ike Wants Space Agency Created out of NACA

WASHINGTON—In a few weeks, Congress will decide if it will go along with the White House to lump control of space research under a new civilian agency.

What the President has asked Congress to do is to create a new office—National Aeronautics and Space Agency—on the framework of the present National Advisory Committee for Aeronautics. The new agency would absorb all present NACA functions, plus take on space research.

TOP SPACE VOICE

If Congress accepts the administration bill establishing the NASA, the agency would become top voice on all space research. Its powers would include authority to build and operate laboratories, testing sites and facilities. Also, it could tap the military for facilities and equipment.

Under the President's proposal, the Department of Defense would still be responsible for space activities "peculiar to or primarily associated with military weapons systems or military operations."

Right now, the NACA and the military are deciding which of the space projects now undertaken by the Pentagon's advanced research projects agency would be transferred to the new agency.

This may produce problems for the White House. For example, both the Air Force and the Army have been given the go-ahead to shoot at the moon.

Spokesmen for the NACA claim that it is this type of project that should fall to the new agency. It could—and most likely would—allow the two services to continue with the projects. But, they would report to the NASA and not to the Pentagon's ARPA. Since the new agency would be responsible for the program, it might well decide to alter the projects. The NACA was not consulted before the projects were undertaken.

In the early days of talk about a civilian space agency, both the Air Force and Navy backed the NACA for the job. The Army, however, wanted space research left to Pentagon control.

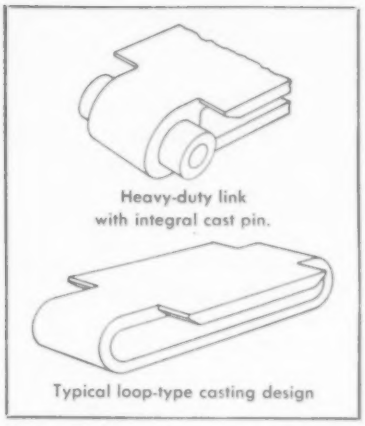
It is certain, however, that none of the services want a civilian agency created that would strip them of any space-research projects, as is thought possible under pending legislation. If this happens, it is sure to bring screams of pain from the Pentagon.

By and large, the NACA—which would become the NASA—is hard put to pick out space projects that should fall to the military to undertake. Such things as reconnaissance satellites and manned rocket-powered bombers likely would go to the military. Primarily, it looks for the military to stay in the ballistic missile field. But, there is a big question of whether the Pentagon chiefs will be content with this role.

There seems to be no question but what the White House's plan to shift the major share of space research out from under the military is tied in with the new reorganization plans for the services. Basically, the re-shuffle of the military structure is designed to strip much of the present power of each individual service and lump it under the Secretary of Defense. But if the new space agency is created, it is sure to move slowly in dealing with the military. It will try hard not to start out feuding with the agencies it will have to work with closely.

To get the new space agency underway, the Administration has asked for some $100-million for fiscal 1959—it is in addition to the $106-million already requested to carry out the regular functions of the NACA. About $7-million of the new money would go for 1,000 new employees—primarily engineers and scientists, and the balance for new facilities and research contracts.

By 1962, the new space agency would be spending around $400-million a year, with the bulk of this going for space research. Present estimates are that the present NACA expenditures of around $100-million a year will remain at this level. An estimated $14-million of the agency funds would go for some 2,000 new employees the agency would likely add by 1962. The NACA now has some 8,000 employees. The big share of the money, would go directly to space research.



Links link together . . .
without connecting rod and make conveyor stronger. Pin cast integrally with each link, upper drawing, is the novel design idea. Typical loop, requiring connecting rod, is shown in lower drawing.

New Link Design Cuts Belt Down time

ELYRIA, OHIO—A new design in conveyor-belt links that puts stress on the links themselves instead of on conventional interconnecting rods, has been developed successfully by American Brake Shoes Electro-Alloys Div.

Reportedly four times as strong as conventional designs, the belt will help solve the problem of conveyor belt "crankshafting" in industrial heat treating furnaces, according to company engineers. Structural feature of the heavy-duty belt is a cast pin link of Thermalloy "50" (35% Ni-15% Cr) that stops crank-shafting, the prime source of failure in belts operating under heavy load and high-temperature conditions. Pitch is 4 in.

Ordinarily, conventional link belts are supported by a wrought rod running laterally through the rows of links. These have little inherent flexibility to "give" under continuous operational stress, and in time, the rods resemble an automobile crankshaft. This causes premature failure as the belt rolls over the driving drum; it twists, developing torsional stresses and galling effects that multiply.

Electro-Alloys says its new cast-pin belt avoids such failure because weight and stress are borne by link itself, with cast pin permitting link self-adjustment and even load distribution.

Design of the belt permits excessively bent or worn cast pins to be removed and new ones to be substituted while the belt is in motion. This used to mean a shutdown.

The new belt design was baptized in tests here under temperatures ranging from 1200 F to 1800 F. Load curves were measured, fractures tested.

Ford Describes Flying Car.

DETROIT—A toboggan-bottomed car that rides a thin film of air may become a common vehicle for travel between distant cities "in the forseeable future" says Andrew A. Kucher, Ford vice president of research and engineering (PE, Mar. 24, p. 29).

The air film to buoy up the car would vary in thickness between 3 and 6 thousandths in and would stream through tiny holes in disks—known as levipads—mounted on the bottom of the vehicle. The air pressure between ground and car would be maintained between 25 and 50 psi. (Lift is derived entirely from air pressure, not reaction to a jet stream.)

Gas turbine or turbo-jet engines are adaptable to supply propulsion for the wheel-less car, and at the same time feed compressed air, drawn from outside, to the levipads. Calculations with experimental models indicate the engines should deliver 50 hp to lift a ton of vehicle weight.

If developed commercially, the conveyance will probably best fit the demand for intermediate range trips between 300 and 1000 mi. Such distances are long for wheeled vehicles, but short for aircraft.

A conveyance built on the air cushion principle would run most efficiently at speeds between 180 and 400 mph say Ford engineers. Potentially, the new concept may increase speed limits for ground transportation. For wheeled vehicles, 200 mph is considered maximum practical speed.

Production and operating costs would likely be relatively modest. The design eliminates many of the mechanical parts in today's autos. Hence, it could be produced reasonably. Further, the air film will eliminate tires—a significant advantage in high speed travel. At speeds of 185 mph reached in the Indianapolis "500" races, cars need to change tires at least once in the course of the competition.

Thoroughfares for the high speed vehicles pose a more difficult problem. Ford engineers suggest cars might ride either suspended or ground-based monorails. The levipads would position the vehicle on the rail.

There appears to be no immediate application for the conveyance, though the Air Force is interested in the principle for their human endurance sleds.

Washington sources say foreign engineers have approached the Navy and maritime officials with a similar system for ships.

Swift glide over a cushion of air . . .
may be in store for ground-travelers in the "forseeable future." A new vehicle concept, the Glideair, has been described by Ford Motor Co. engineers. The vehicle eliminates wheels and road friction would be capable of speeds up to 500 mph.

Desk full of transistors . . .
. . . is Philco Corp's Transac S-1000 data processing system, reportedly the first completely transistorized, commercially available large-scale computer for scientific and industrial use. It has a 36 binary-digit word-length capacity, and a 4096 word memory that can handle over 45,000 alpha-numeric characters. It will perform more than 100,000 additions or subtractions per sec. with a character recall from memory in 12 microsec. Unit fits into a standard office-type desk console, occupies 36 cu. ft., and operates on 110 v, 60 cycle.

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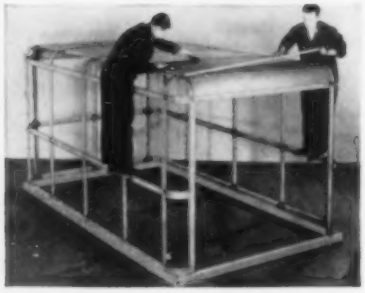

Lindsay Structure panel construction gives added strength for durability and economy. Equal tension in all directions makes a panel of greater strength than the original sheet, and highly resistant to impact damage. New lap-joint components make Lindsay virtually leak-proof. For relatively small housings or enclosures Lindsay Structure carries its own weight . . . on larger or extended structures, enclosure with Lindsay is easy over a basic superstructure.

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Lindsay Structure is not limited by the general restrictions found in other forms of metal housing or enclosure. Easily adapted to stated requirements in length, width and height . . . can be built in any direction in fractional dimensions . . . with all the strength, durability and tightness of other forms of metal enclosure. Alteration in a basic Lindsay Structure is simple. Any dimension can be increased or decreased with ease due to Lindsay Structure special features.

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Big 3 Set Machine Tool Standards

DETROIT—An informal committee from the automotive Big Three has been quietly working with machine tool manufacturers to establish industry-wide standards that will apply to machinery the automobile companies buy.

By the time the preliminary work is completed, some 26 machine-tool companies will have been interviewed. These preliminary talks present the machine-tool companies with the problems the automotive manufacturers face and with the solutions they would like to see appear in the new tools while the machine-tool builders present their own points of view and the problems they face.

Preliminary talks are scheduled to be completed in April, after which the data gathered will be evaluated and integrated into a formal proposal the automobile companies are expected to make to the machine–tool companies in July or August.

Briefly what the automobile companies are looking for is standardization of component design and increased flexibility in new production lines. Design for automation has resulted in large transfer machines which are very efficient in the production of specific parts, but do not lend themselves easily to engineering changes in these parts. As a result, large and expensive machines are scrapped long before the end of their useful life, and retooling is both an expensive and time consuming process.

Ford Motor Co. pioneered in advocating a building block type of construction for their production equipment, and the other companies soon followed Ford's lead.

In this type of construction a line would be composed of a number of individual units, each performing a specific limited function, the units being connnected by transfer mechanisms. Each of the units has the working tools mounted on a base, and ideally would have its own sensing and checking devices.

Standardization would cover size of bases and—as far as possible of working heads. This would make it possible to pull out of the line an individual head and substitute a new one to effect engineering design changes in the part being produced, and in

some instances to substitute a new unit complete with base and with the sensing and checking devices.

Flexibility of the units making up a line is aimed at cutting down the time required to change from production of one model to production of another in the same model year. It would be the equivalent of changing speeds on a lathe by adjusting the positions of some levers as against the older method of removing and replacing a train of gears.

Members of the informal committee are L. G. Ringholz, superintendent, Machinery and Equipment Utilization Section, H. C. Daum, Manager, Machining Process, and I. E. Bellmore, senior buyer, Machinery Purchase for all of Ford Motor Co.; V. A. Williams, automation consultant for Chrysler Corp., and R. R. Mitchell, contract engineer for General Motors Corp., all of whom are contacting machine-tool companies.

Flood Warning System Readied

CHICAGO—A newly installed flood forecasting and warning radio communications system will be operating in Pennsylvania's Susquehanna River Valley in time to prevent tragedy this coming flood season.

Consisting of more than 80 specially designed units produced and serviced by Motorola, Inc., the system provides a network linking the water level and weather reporting stations along the river valley with a central office at Harrisburg Airport, and is operated by Pennsylvania's Dept. of Forests and Waters.

GALAXY OF OBSERVERS

Said to be the world's most advanced, the system allows more than 40 observers to report by voice direct to Harrisburg or to district offices which in turn can communicate with Harrisburg by voice or teletypewriter. The central office in turn can communicate with any of the stations along the river.

The units are designed for reliability and ease of repair. In case of malfunction, an entire subassembly is replaced and the station becomes operative again in a matter of minutes.

This typical application of the Hupp "Data-Tab", lighted by 2,300 G-E 2-pin lamps, posts wheat prices. It can easily be adapted to deliver practically any message—instantly.

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By arranging more than 2,300 tiny G-E 2-pin lamps in rectangular patterns, or modules, and then flashing combinations of the lamps, Hupp Electronics Company's* new data tabulator can spell out any message—instantly! Designed for push-pull sockets, G-E 2-pin lamps are used because they're so easy to install and maintain. Simplified construction of lamps and socket takes less space.

For many applications, the G-E 2-pin lamp offers special advantages. It weighs about half as much as conventional lamps with the metal base. You get positive electrical contact, and because there's no solder to soften, G-E 2-pin lamps give good performance up to 600°F.

Two-pin lamps "live" longer because there's no glass bead needed to hold the heavy-duty lead-in wires. (This means no resonant frequency differential that helps break filaments in other lamps.) Discover how they can give your products improved design and operation—and more sales appeal. For further information on G-E 2-pin lamps write: General Electric Co., Miniature Lamp Dept. PE-48, Nela Park, Cleveland 12, Ohio.

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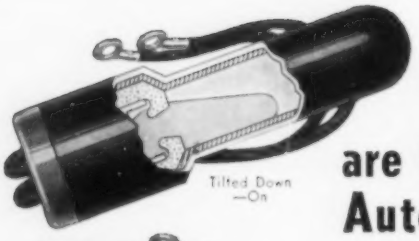

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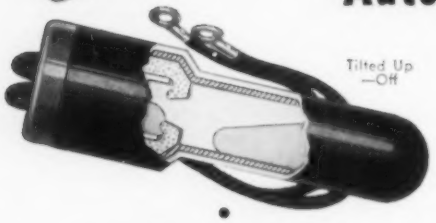

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Reduce Lost Plane Search Time

NEW YORK—A crash-locator beacon operated in conjunction with a world-wide direction-finding network is being developed by the Air Force to eliminate long, dangerous and often costly searches for downed aircraft.

The beacon, designed for bomber and cargo aircraft, can be ejected manually or automatically from aircraft traveling at any speed up to 300 mph.

A static line deploys a small parachute, slowing the beacon to an impact force of less than 50 g. Once on the ground, outriggers are extended automatically to give the beacon a stable base.

The antenna-well rotates until a sensing device stops it face upward. Regardless of altitude of beacon on land or in water, the antenna is automatically erected to a true vertical position, reaching 13 ft at full extension.

A high-frequency transmitter first sends out an alarm signal on the international distress frequency. This automatically alerts the direction-finding network. Then follows a series of SOS signals, a 5-sec bearing tone and the aircraft's identification number.

Next the UHF radio transmits a 5-min tone for search aircraft to home on. Procedure is repeated for 18 hr.

A model of the system is being tested by the Air Force.

Televise X-ray Exams

AMSTERDAM—The first direct, long-distance X-ray examination in medical history was conducted at Montreal with Dutch equipment. Eight miles from a hospital where a patient was being X-rayed, specialists from another hospital viewed on closed circuit television the peristaltic movements of the patient's intenstine—and made a successful diagnosis.

The X-ray images were transmitted by means of a television-beam transmitter using a Philips image intensifier combined with a television camera. The image was transmitted via cable.

The newly-developed equipment will permit X-ray examination in well-lighted rooms, with the examining physician working from an adjacent

office. The doctor will not need protective clothing.

More convenient training of medical students is another important advantage of the new apparatus.

Recommend Control of Jr. Rocketeers

WASHINGTON—Since Sputnik I inflamed the imagination of amateur, mostly youthful, rocketeers, the U. S. press has reported a rash of injuries caused by explosion of "home-made" missiles (see PE–Mar. 17, '58, p. 23).

Last week in Washington, the President's conference on occupational safety took cognizance of the tragedies. It called on government to encourage the amateurs, but also to cut down the hazards to experimenters. The suggested program—formulated by an expert panel of industrial, labor and government people—calls for:

A national program of amateur rocketry, similar to that for rifle marksmanship sponsored by the National Rifle Assn., to be coordinated by the Department of Defense.

Encouraging communities to build static rocket test stands as a public service and staff them with "qualified personnel." Military reserve forces would be local sponsors.

Science Downs Wine

PARIS—The 13-year-old struggle between the U. of Sorbonne and the wine merchants of Paris has been resolved–in favor of science. (See PE–Feb. 24, '58, p. 23).

French courts have annuled the wine merchants' recent complaint against the sorbonne, according the school a new permit to build two buildings directly over the wine market entrances. The science faculty can now sidestep payment of major indemnities.

Proposed buildings would straddle truck and rail wine-delivery entrances. That's why wine wholesalers claim eviction payments. The ruling means the merchants must co-exist with the school or move, a step they resist because of current investment and moving costs.

Construction work already has begun on the new buildings. Teachers are watching for signs of retaliation by the wine merchants, which is unlikely.

design-in CAMLOC...design out costs

These DC amplifiers by Hallamore Electronics Company, Anaheim, California, use Camloc 21L Chassis Latches in place of the usual innumerable pieces of hardware. Besides obvious advantages of dependability, styling, reduction in weight, functionalism, the 21L saves money in production time through design versatility, simplified installation.

CAMLOC®

21L

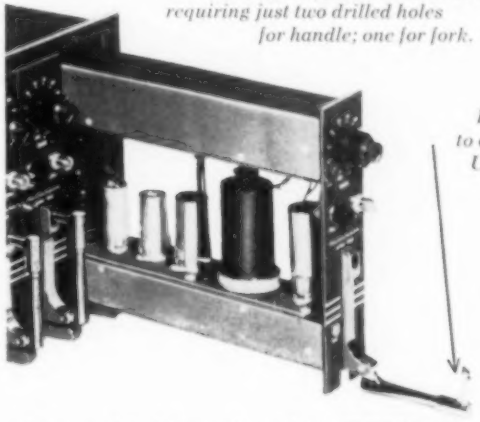
multiple function CHASSIS LATCH

Push-type spring in handle engages and disengages lock in one easy motion.

Cam action is positive, vibration-proof, easily manipulated.

Fork arrangement automatically disconnects and ejects chassis: makes perfect reconnection.

Mounting is quick, economical, requiring just two drilled holes for handle; one for fork.



Handle leverage is sufficient to disengage 400-lb. friction load. Ultimate carrying capacity of closed handle is 600 lbs.

See it on display at the IRE Show, Booths 4306, 4308, March 24-27, NewYork City

Design Engineering Show, Booth 317, April 14-17, Chicago

For complete information, ask for **BULLETIN No. 27L**

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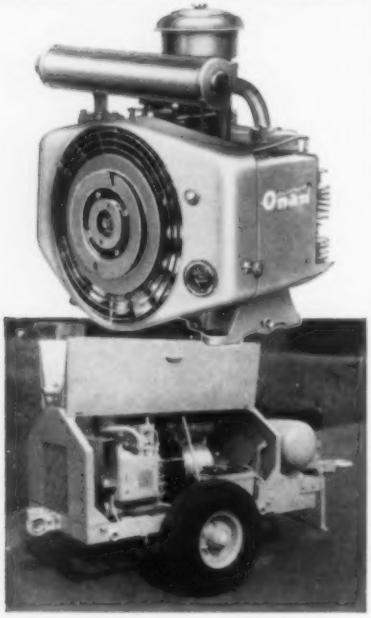
Onan PRODUCTS

AIR-COOLED ENGINE NEWS



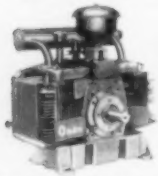
In military service, too...

Onan CCK engines get the tough jobs

This rotary compressor, driven by an Onan CCK engine, is being built in quantity for the Air Force by the Davey Compressor Company. It is rated at 16CFM at 200 PSI and after passing the 1,000-hour continuous operation test, delivered more air per minute than at the start of the test.

The Onan CCK engine combines four major advantages for outstanding performance. It develops 12.9 H.P. yet weighs only 148 pounds. Its alternate-firing, two-cylinder design is compact and free from vibration. Large bearings and rugged construction make it a dependable, long-life power source.

Onan CCK power can step up the performance of *your* equipment.



REAR VIEW showing crankshaft extension. Overall length including crankshaft is 14¾", height 21⅛", width 18½". Rope starting is standard; recoil or electric starting available.

Onan also builds military gasoline engines; air-cooled Diesel engines, electric plants and generators. Write for information.

D. W. ONAN & SONS INC.

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Stepped-up Tape Communication

LAWRENCE, MASS.—Transmission of information at either 1/50th or 1/20th of its recording time is possible with a precision tape-recording-communication system according to Avco Manufacturing Corp's Research and Advanced Development Div.

The two-unit Avcom Compressor-Expander, model CEM-50-1, can transmit voice, digital, teletype, punch-card and all other data—is limited only by the upper frequency of the base bandwidth of the transmission system.

It transfers serialized digital information at the high-speed rate of 1200 wpm. (20:1 compression ratio) on a bandwidth of from 300 to 3000 cps. At 50:1 compression, output is 3000 wpm. for direct operation of a standard teleprinter or tape puncher.

Potential applications for this system include such activities as weather reporting and petroleum operations, where several information points are scheduled to feed into a central collection center. Because of the start-stop time of 2 millisec, the system can also be used where compressed information must be instantly available.

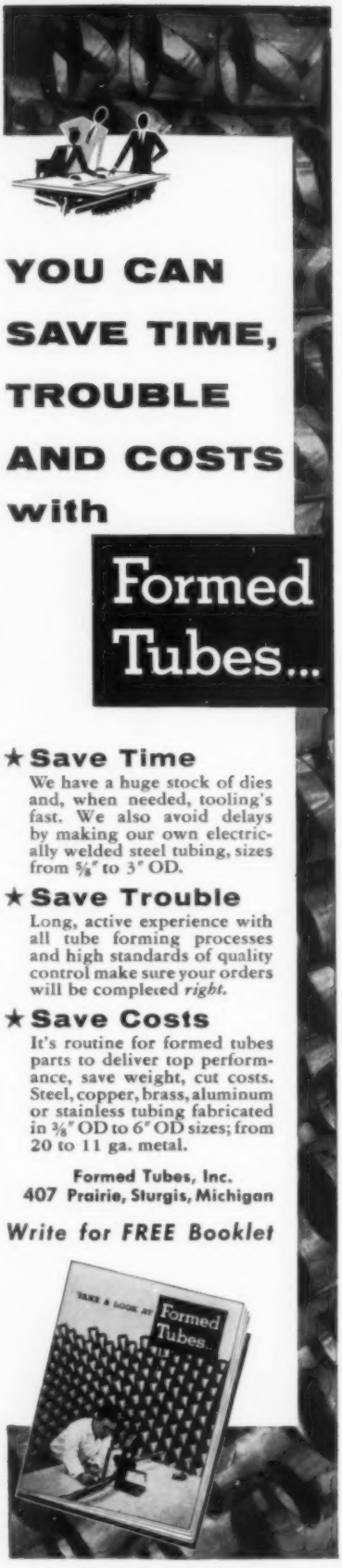
Each unit of the Avcom Compressor-Expander measures 48 in. high, 23 in. wide and 20 in. deep, and weighs 250 lb. Information is compressed to a fraction of its former length in the first console, expanded to its original state in the second. Each console is completely self-contained and consists of a power supply, low-and-high-speed tape-drive system, dual high-speed recording unit, playback amplifier, and erase and bias oscillators.

Tape bins in each console hold 50 ft of standard ¼-in. magnetic tape, enough for 10 min of record or playout.

Stanford Offers Design Course

STANFORD, CALIF.—In June, Stanford U. will offer a two-wk course on creative engineering and comprehensive design. Prof. John E. Arnold, who originated a similar course at MIT, will administer the sessions.

The course is based on studies of the creative process that show people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are born with many potentials but generally develop only a few. The idea is to help engineers identify and apply the gamut of their mental gifts. The course will also help participants organize more creative-engineering departments.

Topics to be covered include: intellectual factors facilitating creativity, emotional and physical factors of creativity, general systems approach as a tool of problem analysis, semantics and problem statement, and psychology of thinking and the influence of the subconscious.

A-powered, Winged Missile Top Deterrent?

LOS ANGELES—A fleet of atomic-powered, winged missiles, cruising endlessly through the atmosphere in a condition of immediate readiness for thermo-nuclear retaliation, was described as "a powerful deterrent to war and a tremendous instrument for world peace," by Dr. William F. Ballhaus, vice president of Northrop Aircraft, Inc. and general manager of Nortronics, the firm's electronics division.

Such missiles, Dr. Ballhaus said, speaking before the Space Age Conference, would have the advantage of unlimited range through the use of atomic power plants, and would not need refueling. He cited advances being made in atomic-power plants. Because there would be no crew members, it would not be necessary to return the missiles to their bases other than for periodic maintenance.

The missiles would be guided by onboard electronic equipment that would be programmed for indefinite hovering in the upper atmosphere. A ground signal to the guidance equipment would initiate an attack on a preselected or designated target. Such guidance equipment is technically feasible at this time.

The statement was made during a speech on "The Anatomy of the Winged Missile" during which Dr. Ballhaus spoke at length on the growth potential of the winged missile. He stated that, despite recent advances in the ballistic missiles, the functions of modern air warfare can never be expected to completely leave the atmosphere. "The winged missile will continue to occupy a prominent position in our air arsenal," he said.

PRECISION CAMS PACK AUTOMATION INTO INCHES...

Ultra precision Parker Cams are responsible for performing many superhuman control functions in jet aircraft, missiles, rockets, instrumentation, wherever environmental extremes make precision mechanical control an asset.

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3 Dimensional Cams compactly perform the function of the heart of an analog computor . . . Z=f(x,y). Parker develops experimental, prototype and production quantities of these cams and is a pioneer, having machined thousands of unusual and exacting 3 Dimensional Control Contours.

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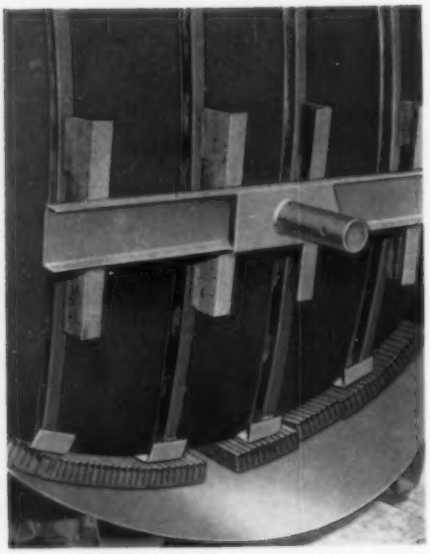
Rubatex provides "built-in" temperature control – sanitation – additional payload!



2" layer of Rubatex is applied between inner and outer shells of stainless steel milk tank. Rubatex is applied to inner shell with an adhesive between steel ring stiffeners used around inner tank. Thin layer of Rubatex also used over ring stiffeners—eliminating metal to metal contact. Outer shell is then wrapped around the Rubatex.

Rubatex answers need for careful temperature control in transporting milk as it has lowest heat conductivity (K Factor 0.21) of any known structural material and maintains its insulating efficiency indefinitely.

Rubatex's closed cellular structure also eliminates any possibility of bacterial growth between shells of tank—an important feature in handling liquid foods of any kind.

Last—by no means least—Rubatex's light weight helps give Standard Steel Works one of the lightest farm pick-up tanks on road today—providing owner with an additional payload on his choice of truck.

In Standard Steel Works' own words: "After considerable investigation, we found Rubatex was the best low temperature insulation available anywhere."

Insulation efficiency, moisture and vermin proof qualities—plus extreme light weight—determined choice of Rubatex Insulation Hardboard as insulation for Standard Steel Works' 1700 gallon "Payloader" farm bulk pick-up tank.

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Soviets Claim World's Top Solar Power Station

LONDON—Russia has designed the world's largest solar-power station for the Aparat Valley in Armenia, according to Soviet news.

Soviet news says Dr. Valentin Baum told a solar-engineering conference in Moldavia recently that 2,500,000 kwhr of electricity and 20,000 tons of steam annually would be generated by mirrors with a total area of five acres.

It was planned, he said, to mount 1,300 mirrors on special carriages to move automatically along 23 concentric railways. The boiler on to which the sun's rays are to be mirrored will be erected on a 130-ft tower.

More than 107,000 sq ft of flat solar heaters are presently in operation in Russia, Soviet news says. And work has begun on building the country's largest flat solar water heater in the Crimea.

In the next three years, 1,300 solar installations for light industry will be constructed in Moldavia. The republic is climatically suitable for the use of solar energy, the newspaper says. It has been estimated that Moldavia is irradiated by solar rays with a total capacity of 20,000,000 kw, and that solar installations can operate there for 200 to 300 days in the year.

. . . they also Announce New Science City

Moscow—The Russians expect to have their big new science city in Siberia open for business by the end of 1959.

Pravda recently quoted Academician M. Lavrentiev as saying the first buildings in the big center outside the Western Siberian metropolis of Novosibirsk will be completed by the end of the year. Most of the center's scientific establishments and research institutes should be operating by late 1959, he said.

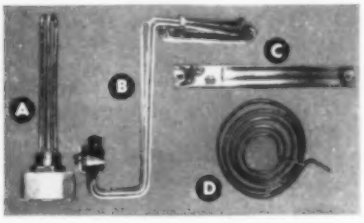
Eight academicians and 27 corresponding members of the Soviet Academy of Sciences will head the operation which has been billed as one of the world's foremost scientific centers.

This is not the first effort to bring intellectual life to Siberia. Cultural centers have been created at Kharkov, Sverdlovsk and Tomsk—the first being a success, the second reasonably so, and the third a flop.

How to choose electric heaters for liquid heating applications

Here is condensed information to help you get the most economical electric heaters for your liquid heating design problem.

Three factors generally determine which type heater should be used for any particular liquid-heating application. They are: the physical characteristics of the container, the nature of the liquid, and the temperature requirements.



General Electric "screw-in" immersion heaters (a) have threaded headers, which make for easy and permanent installation in pipes, tanks and vessels. "Over-the-side" immersion heaters (b) hang in tanks or containers, and besides being portable, they are ideally suited for heating rubber-lined tanks, lead-lined tanks, tanks of wood, slate, and other materials which are not adaptable to heaters with threaded headers.

Because some metals are subject to attack when immersed in certain liquids, G-E heaters are made in a variety of sheath materials so that they can be used for a wide range of liquids. Sheath materials of copper, steel, stainless steel, nickel, nickel-plated copper, nickel-silver, Inconel, Monel, cast iron and lead are all available.

General Electric heaters are ideally suited to heating a wide range of liquids: Water, oil, electroplating baths, cleaning compounds, chemical baths, and other fluids. These liquids can be circulating or non-circulating; in open containers, closed or pressure, vessels, kettles, or steam generators. Heavy viscous liquids, such as pitch, molasses, and asphalt can be heated by using a liquid jacket containing immersion heaters.

Where extremely corrosive liquids are to be heated, it is also often best to use a water jacket around the tank. Immersion heaters may be used for water heating in this type of application. Many times, it is easier to clamp strip heaters (c) or tubular heaters (d) to the side of the tank.

TABLE I—Water, Alkaline or Plating Baths

Amount of Liquid		Degrees F Temperature Rise						
Cubic Feet	Gallons	20	40	60	80	100	120	140
		Kilowatts to Heat in One Hour						
.66	5	0.3	0.5	0.8	1.2	1.6	2	2.7
1.3	10	0.5	1.1	1.6	2.4	3.2	4	5.3
2.0	13	0.8	1.6	2.4	3.6	4.5	5.7	7.2
2.7	20	1.1	2.2	3.2	4.8	6	7.5	9.5
3.3	25	1.3	2.7	4	6	7.5	9.5	12
4.0	30	1.6	3.2	4.8	7	8.8	11	14
4.7	35	1.9	3.7	5.6	8	10	13	16
5.3	40	2	4	6	9	12	15	20
6.0	45	2.4	5	7	11	14	18	23
6.7	50	2.7	5.4	8	12	15	19	24
7.4	55	3	6	9	13	16	20	25
8.0	60	3.3	6.4	9.6	14.5	18	23	29
8.7	65	3.5	7	10	15.5	19.5	25	31
9.4	70	3.7	7.5	11	17	21	26	33
10	75	4	8	12	18	23	29	37
10.7	80	4.3	8.5	13	19	24	30	38
11.4	85	4.5	9	13.5	20	25	31	39
12.0	90	5	10	14.5	22	28	35	44
12.7	95	5	10	15	23	29	37	47
13.4	100	5.5	11	16	24	30	38	48
16.7	125	7	13	20	30	38	48	60
20.0	150	8	16	24	36	45	57	72
23.4	175	9	18	28	42	53	67	85
26.7	200	11	21	32	48	60	75	95
33.7	250	13	27	40	60	75	95	120
40	300	16	32	47	70	88	110	140
46.8	350	19	37	56	83	105	130	165
53.4	400	21	43	64	96	120	150	190
60.1	450	24	48	72	107	135	170	214
66.8	500	27	53	80	120	150	190	240
Maximum Time (hours)		10	10	7	5½	5	4	3½

TABLE II—Use This Table For Oil

Amount of Oil To Be Heated		Degrees F Temperature Rise					
Cubic Feet	Gallons	50	100	200	300	400	500
		Kilowatts to Heat in One Hour					
.5	3.7	.3	.5	1	2	2	3
1	7.4	.5	1	2	3	4	6
2	14.9	1	2	4	6	8	11
3	22.2	2	3	6	9	12	16
4	29.9	2	4	8	12	16	22
5	37.4	2	4	9	15	20	26
10	74.8	5	9	18	29	40	52
15	112.5	7	14	28	44	60	77
20	149.6	9	18	37	58	80	102
25	187.	11	22	46	72	100	127
30	222.5	13	27	56	86	120	151
35	262.	16	31	65	100	139	176
40	299.	18	36	74	115	158	201
45	336.5	20	40	84	129	178	226
50	374.	22	45	93	144	197	252
55	412.	25	49	102	158	217	276
60	449.	27	54	112	172	236	302
65	486.	29	58	121	186	255	326
70	524.	32	62	130	200	275	350
75	562.	34	67	140	215	294	375
Maximum Time (hours)		10	10	8	7	6	5

To figure the amount of heat required for your application:

1. Find the number of gallons or cubic feet of liquid to be heated.

2. Figure needed temperature rise in degrees F. (Subtract initial temperature from needed temperature.)

3. Check either Table I or Table II from the nearest amount of liquid to the desired "temperature rise" in the right-hand column.

4. Add 4% to the figure you now have if there is no insulation on your container or tank.

5. Divide the answer in Step 4 by the number of hours available for initial heat up of the liquid. You now know how many kilowatts of heat are required for your installation.

For complete information on sizes and ratings of General Electric heaters, call your General Electric Apparatus Sales Office or send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

SPECIAL SAMPLES: Your General Electric sales engineer can advise you on special heating problems. If special heaters are required, he will provide samples.

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FINAGLE'S LAWS

. . . or why nothing in Research and Development happens the way it should.

IF ANYTHING CAN GO WRONG WITH AN EXPERIMENT

■ Ever since the first scientific experiment, men have been plagued by the unceasing antagonism of Nature. Only his patience, adaptability and forebearance have permitted the scientist to learn a few minor facts about the operation of the universe.

We still do not really know why this should be so. It's only natural that Nature should be logical and neat —but it isn't, and the best teacher of all, Experience, turns out to be just the gradual acceptance of Nature's pigheadedness.

Over the years a series of laws have evolved. The laws actually represent a distillation of experience of thousands of experimenters, but (until Dr. Finagle came along) they were never recorded for the study and edification of younger members of our profession because they had no derivation—no proof. They are true because they have always been true. Look into your own experience and see if this is not so.

We are grateful to John W. Campbell, Jr., editor of *Astounding Science Fiction*, for bringing this work to our attention, and to the many readers of that magazine who collected and contributed samples so that others might share in their experience.

ON EXPERIMENTS

The first four laws are the only one dignified by number. Note the beauty and simplicity of the First Law. Also note that the remaining three laws refer to men's reactions to Nature—not to Nature itself.

First Law: If anything can go wrong with an experiment, it will.

Second Law: No matter what result is anticipated, there is always someone willing to fake it.

Third Law: No matter what the result, there is always someone eager to misinterpret it.

Fourth Law: No matter what occurs, there is always someone who believes it happened according to his pet theory.

The Law of the Too, Solid Goof

In any collection of data, the figure that is most obviously correct—beyond all need of checking—is the mistake.

Corollary I—No one whom you ask for help will see it, either.

Corollary II—Everyone who stops by with unsought advice will see it immediately.

A further series of rules—or really advice to experimenters—has been formulated. They are a natural consequence of the first four laws reduced to day-to-day practice.

Experiments must be reproducible—they should all fail in the same way.

First draw your curves—then plot the readings.

Experience is directly proportional to equipment ruined.

A record of data is useful—it indicates you've been working.

To study a subject best, understand it thoroughly before you start.

In case of doubt, make it sound convincing.

Do not believe in miracles—rely on them.

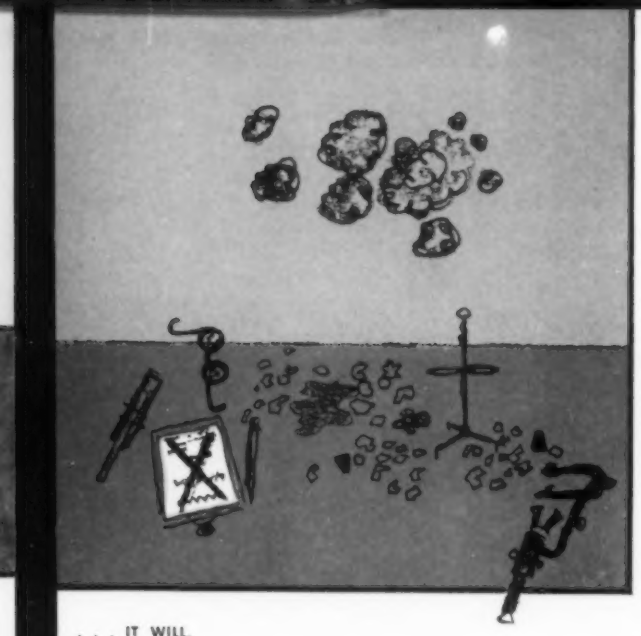
Always leave room to add an explanation when it doesn't work. (This open-door policy is also known as the Rule of the Way Out.)

HUMAN FOIBLES

The remaining rules outline the human problems that follow from the above. To some extent they represent man's reaction to Nature and, even more aptly, man's reaction to man.

Laws of Revision (Often lumped into the Now They Tell Us! Law)

First Law: Information necessitating a change of design will be conveyed to the designer after—and only after—the plans are complete.



. . . IT WILL.

Corollary I—In simple cases, where one obvious right way is opposed to one obvious wrong way, it is often wiser to choose the wrong way right off. This is one step ahead of choosing the right way, which turns out to be a wrong way, which has to become a right way.

Second Law: The more innocuous the revision appears to be at first, the further its influence will extend and more plans will have to be re-drawn.

Third Law: If, when the completion of a design is imminent, field dimensions are finally supplied as they actually are—instead of as they were meant to be—it is always simpler to start all over.

Fourth Law: Even if it is impossible to assemble a part incorrectly, still a way will be found to do it wrong.

Corollary I—It is usually impractical to worry beforehand about interferences—if you have none, someone will make one for you.

The Law of the Lost Inch:
In designing any type of construction, no overall dimension can be totaled correctly after 4 p.m. Friday.

Corollary I—Under the same conditions, if any minor dimensions are given to ⅛ of an inch, they cannot be totaled at all.

Corollary II–The correct total will be self-evident at 9:01 Monday morning.

Deliveries that normally take one day will take five when you are waiting.

When adjusting (or drawing or computing, etc.) remember that the eye of the chief inspector (engineer, draftsman, etc.) is more accurate than the finest instrument.

After adding two weeks to a schedule for unexpected delays, add two more weeks for the *unexpected* unexpected delays.

In any problem, if you find yourself doing an unending amount of work, the answer may be obtained by inspection.

Finagle's Creed:
Science is Truth—don't be misled by facts.

Finagle's Motto:
Smile—tomorrow it will be worse.

THE FINAGLE FACTOR

A mathematical notation of Finagle's work has also been developed. Here, however, there seems to be some confusion, because two other names enter the picture: *fudge* and *diddle* factors are also used to considerable advantage by scientists and engineers.

Years ago—when the universe was relatively easy to understand—the Finagle factor consisted of a simple additive constant (sometimes known as a variable constant) in the form:

$$x' = K_F + x$$

Where any measured variable, x, could be made to agree with theory, x′, by simple addition of the Finagle factor, K_F.

Later difficulties couldn't be solved so easily and so a fudge factor K_B, was added.

$$x' = K_F + K_B x$$

Powerful as this adjustment was, World War II studies in servo theory indicated a need for a still stronger influence. The diddle factor, K_D, was born and made to multiply the quadratic term.

$$x' = K_F + K_B x + K_D x^2$$

It is felt that, at least at present, reality can be made to conform to mathematical theory with reasonable agreement on the basis of these three factors.

However, John W. Campbell feels there is a different basic structure behind the Finagle, fudge and diddle factors. The Finagle factor, he claims, is characterized by changing the universe to fit an equation. The fudge factor, on the other hand, changes the equation to fit the universe. And finally, the diddle factor changes things so that the equation and the universe *appear* to fit, without making any real change in either.

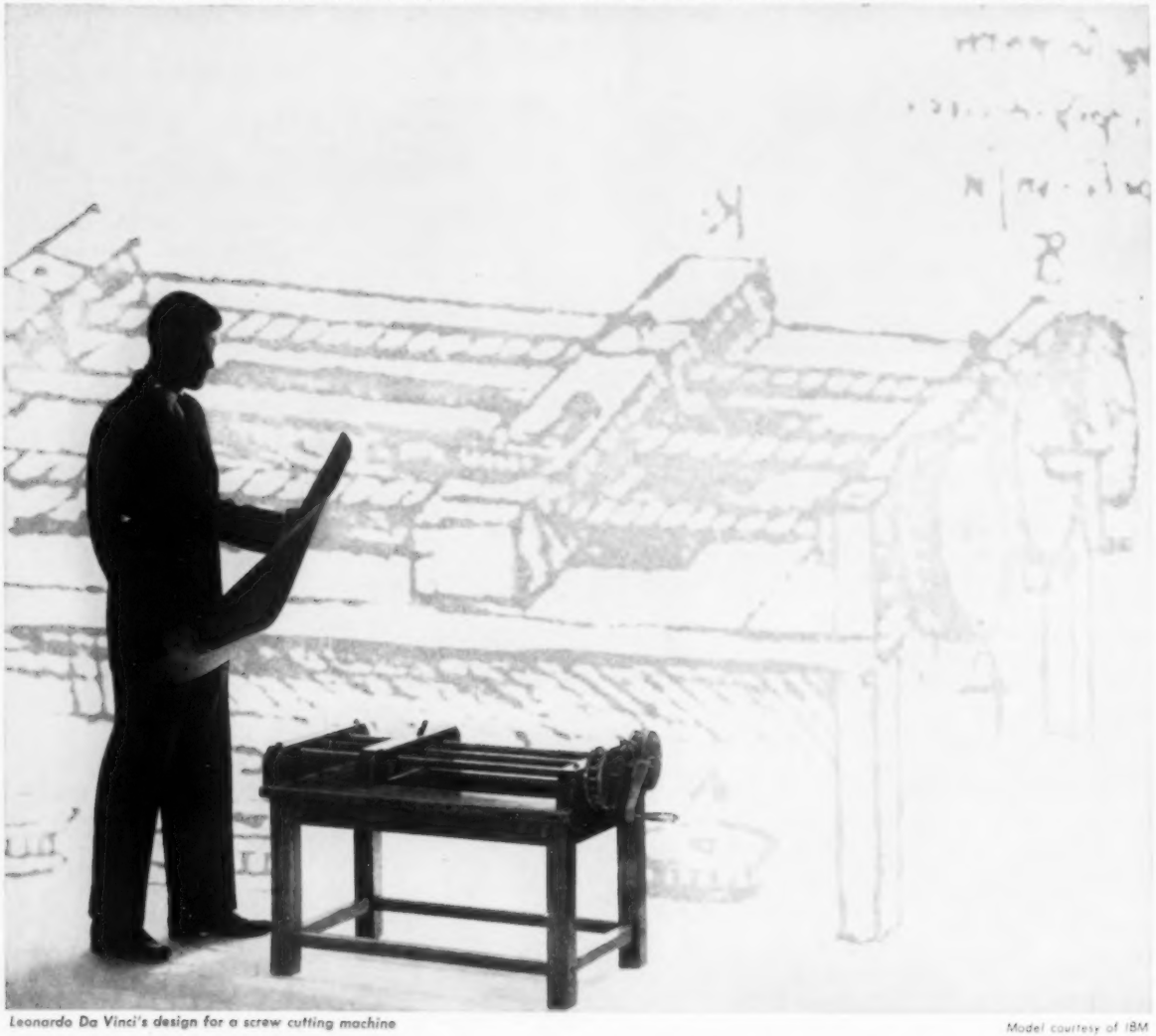
For example, the planet Uranus was introduced to the universe when Newtonian laws couldn't be made to match known planetary motions. This is a beautiful example of the application of the Finagle factor.

Einstein's work leading to relativity was strongly influenced by the observed facts about the orbit of Mercury. Obviously a fudge factor was introduced.

The photographer's use of a "soft-focus" lens when taking portraits of women over 35 is an example of the diddle factor. By blurring the results, photographs are made to appear to match the facts in a far more satisfactory manner.

To our knowledge, this is the first clear enunciation of the scientific method. All our vast sum of human knowledge has been derived with these as the basic tools. Having them in writing for the first time, perhaps our children can build even better futures than the best we envision today. ■

creative designing calls for an open mind



Leonardo Da Vinci's design for a screw cutting machine

Model courtesy of IBM

EVEN THIS DA VINCI DESIGN COULD HAVE BEEN BETTER WITH HELP FROM AN SKF ENGINEER.

The kind of bearings your SKF engineer recommends depends solely on your requirements, not on what he has to offer. That's because the SKF line includes all four basic types of ball and roller bearings in many thousands of sizes. This gives him the kind of flexibility he needs to keep an open mind on any bearing problem. Give your problem to SKF and see.

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Spherical, Cylindrical, Ball, and "Tyson" Tapered Roller Bearings

EVERY TYPE—EVERY USE

SKF

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.

*REG. U. S. PAT. OFF.

Don't Let SALESMEN Plan Your Products

IRWIN P. SHARPE, *Management Consultant*
West Orange, N. J.

■A salesman, so the theory goes, is on the firing line —as close to the customer and his needs as it is possible to get. If he is a good salesman he knows his market, he knows his customer, he knows what products and features his customers want—so the theory goes.

Well, it just isn't so. Salesmen are excellent sources of product ideas, but they are emotional, enthusiastic, and their memories are limited to last week's lost sale. Their ideas must be sifted and evaluated. They offer opinion, not facts. And, being good salesmen, they can often sell their opinions, to management's ultimate sorrow.

One manufacturer let his sales department talk him into redesigning his line of industrial temperature controls. A novel method of controlling range settings and a high-fashion instrument case would double sales, they insisted. So a team of crack engineers took two years and $200,000 to develop prototypes.

The prototypes worked, they were beautiful, but when the manufacturer contemplated his tooling cost he got cold feet. He wanted a little objective assurance that remote control and beautiful cases were what the customers wanted—and would pay for.

So, over salesmen's protests the manufacturer set an independent market researcher to work and, just to hedge his bets, set a company group to see what they could find as well.

Both groups made the same report. The customers didn't need, didn't want, and still worse, wouldn't pay for the new features. The reports were so gloomy that the manufacturer decided to shelve the whole project. The executives lost face, the company lost $200,000 and engineering lost two years—all of which might have been avoided with an immediate, and scientific, survey.

The Gang Approach

Often distributors and salesmen lock arms to pressure a manufacturer into putting a new product on the market. The combined attack is pretty nearly irresistable. Distributors, too, are on the firing line. And as far as the manufacturer is concerned, they are his only real customers.

One air-conditioner manufacturer was overwhelmed by his exuberant sales manager and top distributor. The two had carefully "analyzed" their market and, in glowing terms, described the need for a small, central air-conditioning unit for low-priced homes.

The manufacturer underwrote a market study. It showed that while there was a vast *latent* market for the proposed product, it would be a good long time before customers started beating a path to his door.

Still, the researchers might be wrong. After all, whom can you trust more, your own sales manager or a group of strangers? The manufacturer set his engineering team at work developing the small air conditioner. But, just in case, instead of tooling up to make the new model by the thousands, only a few hundred new models were made. With $150,000 worth of baby air conditioners in his warehouse, the manufacturer sat back and waited for the distributor's carload orders.

He may still be waiting. After two years the distributor had ordered a total of five units. Even at a price far below cost, the inventory barely moved. The sales manager and the distributor sang a familiar tune: "You were too late."

But was he? Certainly the high-fashion market requires split-second timing, but in hard goods "poor timing" is just sales staff cover-up. The real cause of failure was: The market never existed except in the minds of an imaginative salesman.

The salesman is insulated from the customer by a wall of distributors and wholesalers. Distributors and wholesalers are, in turn, screened from customer contact by the retailers. And an insulated salesman or distributor can't tell you what a customer wants. He only knows if the customer likes or dislikes what is offered—and the manufacturer often knows as much about that as he does.

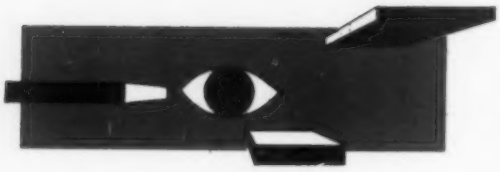
Further, most salesmen have no idea of the technical problems and costs of new-product development. To them, engineers live in a strange world of blueprints, slide rules and drafting boards, and can—with prodding —develop just about anything required. They usually can, but it helps to be sure that the *market* really requires it. Research time and development costs seem negligible when compared to the pot of gold at the end of a favorite rainbow.

The case against the salesman is summed up by the National Industrial Conference Board: "Because they're anxious to serve their own accounts, salesmen . . . may misjudge the extent of the market for the new product" and "are frequently unaware of the technical problems which must be overcome."

Substitute for Salesmen's Ideas

Begin with market research. Sure get the salesman's opinions, but be absolutely certain you get to the man who makes the buying decision, too. Then, "the research man or engineer will know he is working on a product for which a need has been established. The value of that product provides his incentive. He need never face the frustration and disappointment of having years of effort put on the shelf because his technical success was unfortunately an economic failure. And the fact that fewer research and engineering dollars go down the drain is no small consideration." These are the words of M. E. Mengel, Burroughs vice president of product planning.

The moral? Don't let your salesman do your product planning. For that matter, don't let your engineers or executives do it either. If the product is going to be a marketing success, don't let anyone make decisions based on opinion. Get the facts, analyze them carefully, cold-bloodedly. This is what makes new products successful. ■



POINTS

THE QUESTION: **Should the Engineering Profession Adopt Collective Bargaining Techniques?**

"The engineering profession . . .

E. LAWRENCE CHANDLER
Assistant Secretary
American Society of Civil Engineers
Treasurer of The Engineers Joint Council

already has expressed itself with respect to collective bargaining by professional engineers. Such statistics as are available indicate that less than 10% of all those who place themselves in the category of 'professional engineers' in the United States are members of groups devoted to collective bargaining. In this connection, it must be recognized that the qualifications of many who lay claim to the title make their standing as truly professional people rather dubious. Understandably, the acceptance of unionization has been primarily in large organizations and, generally, where only a moderate degree of professional competence is required to meet the demands of employment.

"It is reasonable to consider that, on the whole, engineers who are members of the national societies representing their respective branches of the profession are more professionally minded and competent than those who either are not qualified or are not sufficiently interested to be members. Hence, opinions of the memberships on any matter affecting the profession are significant. Such opinions regarding collective bargaining are available. Four of the major constituent societies of Engineers Joint Council polled their members in 1953 and 1954. Returns showed that 72% opposed collective bargaining for professional engineers and 66% felt that it was incompatible with professional status. Less than 4% were members of established collective bargaining groups. A survey of the members of the American Society of Civil Engineers, in 1957, indicated that 84% disapproved of collective bargaining, with 72% believing it tended seriously to 'undermine professional standing of engineers as a whole.' It is of interest to note that 42% of ASCE members are young men in the Junior Member grade. These statistics demonstrate that a substantial majority of the more competent members of the profession definitely answer 'no' to the question posed."

OF VIEW

JOSEPH AMANN
President, Engineers and Scientists of America

"Industrially employed engineers . . .

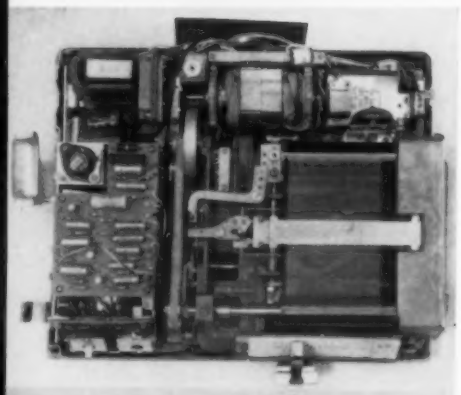
not only should adopt the technique of collective bargaining to solve the many problems which beset them as employes, but we in ESA are convinced that inevitably they must adopt that technique. The frustrating and seemingly insolvable problems which plague engineers in industry—particularly that portion of industry where engineering departments are large in terms of numbers of engineers—are in many respects similar to, and in some respects the same as, the problems which other groups of employes in the same companies have solved by collective bargaining, or hope to solve by employing that technique. Problems of concern to engineers, and which come to mind readily, involve such issues as salaries, merit increases, advancement, working conditions, technical development, proper utilization of talents, forced specialization, etc. Even though these problems exist generally throughout industry, to a greater or lesser degree, they are essentially local in nature and become capable of solution only when attacked on a local or company-by-company basis.

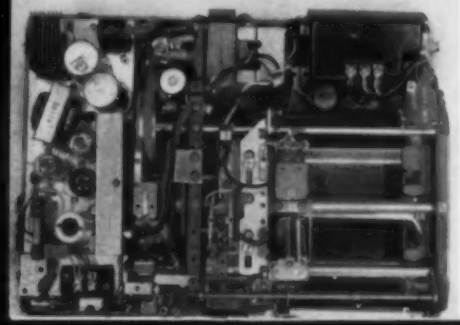
A few of the major technical and professional societies (most notable among these are the Engineers Joint Council and the National Society of Professional Engineers) have, in some measure, recognized the unhappy lot of industrially employed engineers and scientists and have come to understand that individual engineers without the aid of effective organized effort are incapable of coping with the unsatisfactory, morale-sapping and initiative-deadening conditions which are more or less standard fare in industrial engineering departments. It is probably because they have come to understand these matters that the EJC and NSPE have for some time engaged in what might be termed an amorphous and informal form of bargaining. They engage in this by the employment of various devices—among them, their salary surveys which are published either annually or bi-annually and which are, we think, heavily distorted by including the salaries of engineering managers, people whose primary functions are administrative rather than engineering. These surveys are intended to persuade management to pay its engineers more money and to convince the engineer that a rewarding future lies ahead even if he does nothing to insure such a future except keep his nose to the grindstone.

"Another gimmick the societies use as 'management persuaders' in their efforts to represent engineers is their periodic lists of 'do's and don'ts.' These lists usually imply, in subtle fashion, that if management will follow the suggestions given, it can keep its engineers from becoming disenchanted —and do so cheaply. Besides these and other similar devices used by the societies is their continuous promulgation of the 'love-your-engineers-dearly and treat-them-kindly' philosophy which is supposed to transform a realistic and practical management into an altruistic group of softies. The societies cannot enforce changes and improvements which they know must be made since they have no legal status, as does a certified engineering union.

"A group of engineers in a company or plant who engage in collective bargaining can, on the other hand, make demands upon management for improvements in salaries, working conditions and a variety of other matters. When such demands are made by an engineers' union, management is compelled, as a matter of law, to negotiate with the representatives of the engineers until a mutually satisfactory agreement has been reached. This agreement is usually reduced to writing and becomes a contract. The contract prescribes the terms and the manner in which the company will deal with its engineers during the life of that contract, as well as providing for minimum salaries almost always tied to a job classification system. It provides for merit reviews and merit increases—the company always determines who should get the increase and how much. In cases of promotion, the company always decides who should be promoted and to where. The contract negotiations promote two-way communications between engineers and management. The contract almost always provides grievance machinery by which matters not covered in the contract can be resolved to the mutual satisfaction of the parties. Negotiations are conducted in a democratic fashion.

"Collective bargaining is the only tool which can effectively cope with the multitude of complex problems existing in the engineering departments of a modern corporate enterprise because: 1) it is democratic; 2) it is local in character in that it involves primarily the engineers in the plant and the company's management; 3) it deals with and solves problems as they arise; 4) it is a completely legitimate and wholly legal process. Engineers should, and eventually will, adopt the process of collective bargaining as the tool with which to raise their professional and economic status."





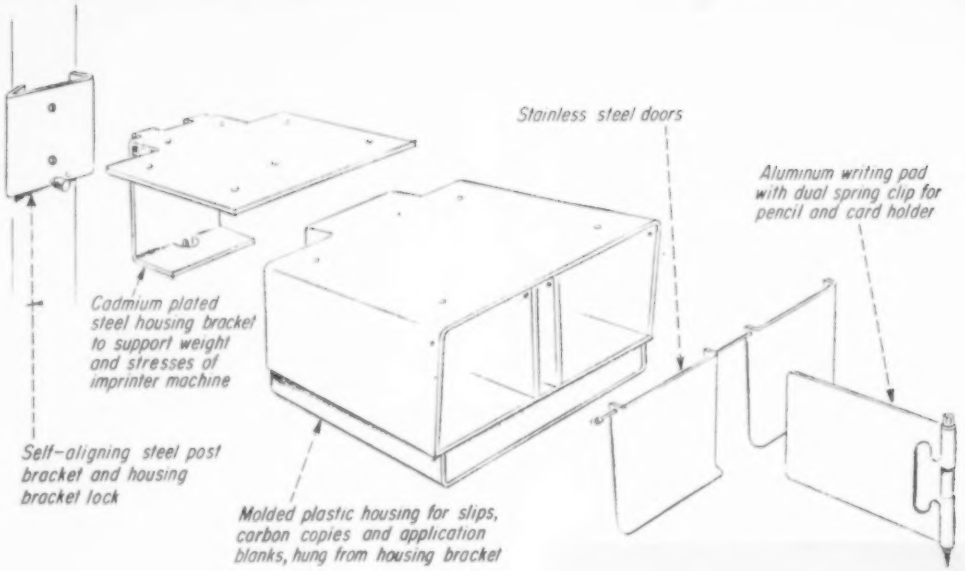
Dictating machine is completely redesigned to simplify operation, and reduce size and weight. Locating all control buttons on the microphone, under the user's thumb, simplifies operation. Extensive use of aluminum for mechanical components, a magnesium case and transistorized amplifier result in a 20% weight reduction over previous units. The transistorized amplifier, in new model (upper left), eliminates both the bulk and weight of vacuum tubes. Additional advantages of transistors are their sharply reduced power consumption, elimination of warmup, and cold operation. Nylon gears plus a capacitor motor specifically designed for this unit reduces both mechanical and electrical noise in the system. Primary drive is by friction using rubber against an aluminum wheel, ceramic-coated for improved frictional and wear properties.

All assemblies are interconnected by plugs and can be removed separately. Final assembly or service involves no soldering, pretested assemblies are plugged together and fastened to the base. Each assembly may be removed for service or testing without disturbing other components.

Designed by Gordon Florian, Fairfield, Conn.; microphone is by company design group — both for Dictaphone Corp., Bridgeport, Conn.

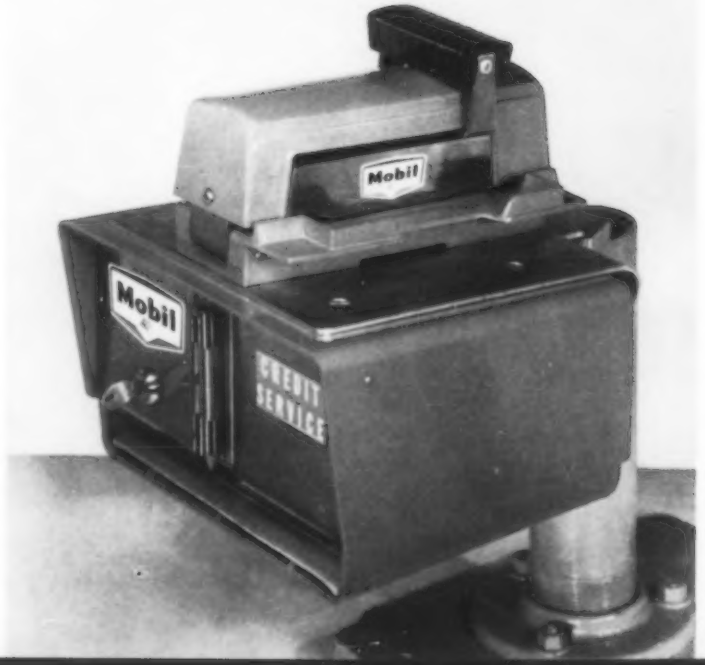
TRENDS

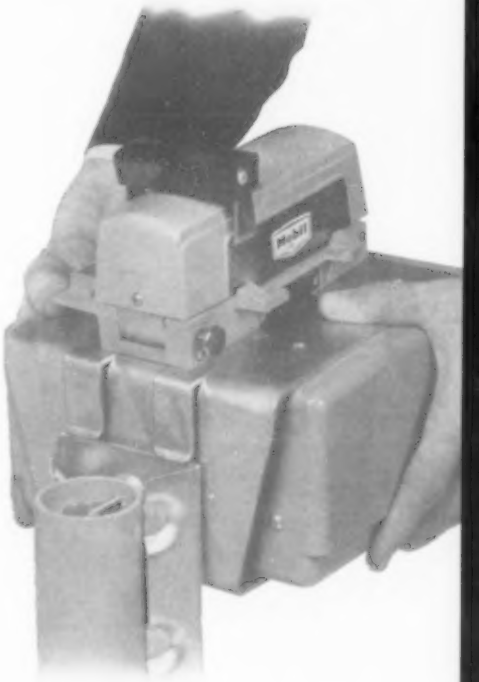
TRENDS in appearance design...


Stainless steel doors
Aluminum writing pad with dual spring clip for pencil and card holder
Cadmium plated steel housing bracket to support weight and stresses of imprinter machine
Self-aligning steel post bracket and housing bracket lock
Molded plastic housing for slips, carbon copies and application blanks, hung from housing bracket

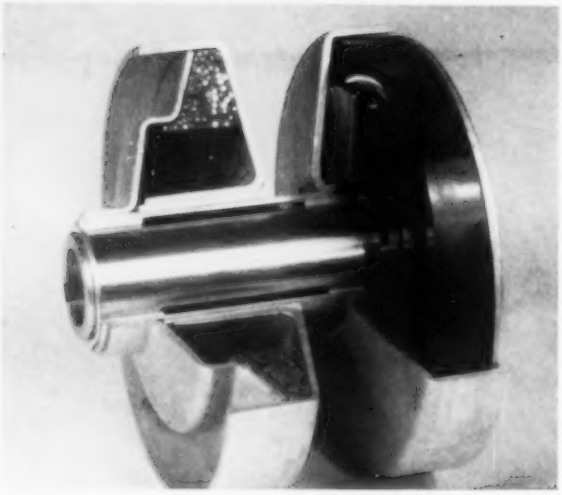
Machine for imprinting charge data from service-station credit cards on sales slips uses a U-shaped steel bracket to support machine and enclose forticel housing. Multi-compartment housing is in one piece, with inherent color to match client's color scheme. Once housing is attached, imprinted mounting screws become inaccessible to other than authorized personnel.

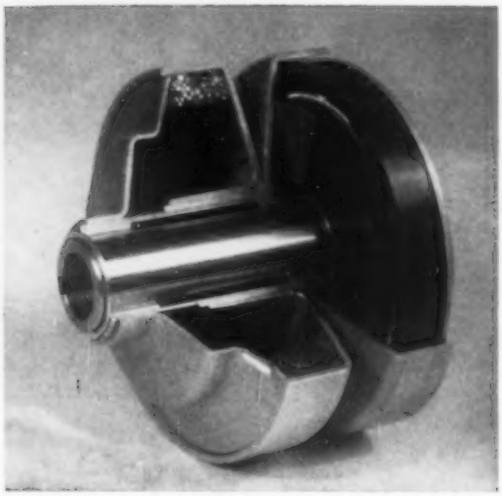
Previous model using same imprinting mechanism used a non-reciprocating actuating handle and shaft, which had to remain dangerously extended after every other use. Overhead location of handle keeps it safely within limits of housing. Cost of this imprinting unit is lower than comparable equipment. By Peter Schladermundt Associates, New York, with Farrington Mfg. Co., and Socony-Mobil Oil Co. engineering department.





SIGNIFICANT PARTS

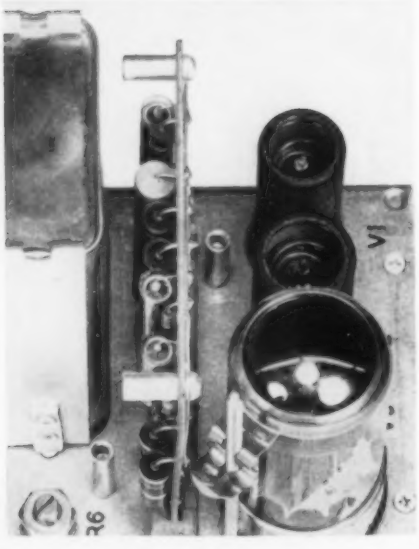




V-belt pulley with automatic torque conversion . . .
alters pitch and pulley ratio as speed and/or load changes. Movable face forms one wall of chamber containing metal shot (left photo), which under centrifugal force generates pressure proportional to speed and load and causes sheave face to move outward on shaft (right photo). Wedging action of belt reverses this movement when speed decreases. Device also acts as a clutch on electric motors, permitting motor to attain full speed before shot applies pressure to start moving load. Because pressure area between shot and pulley chamber which encloses it is responsive to varying load and speed at given throttle setting, converter functions as a regulating mechanism in some applications.

Manufacturer also makes a companion clutch that makes possible application of converter to small gasoline engines, where standby service requires idling without engaging load. Clutch is based on a shaft-mounted cam, which forces segmented clutch elements into contact with outer friction ring. Point at which engagement occurs can be varied. Because declutching is sharp and quick, belt slippage is said to be virtually eliminated. Torque converter measures $3\frac{11}{16}$ x $4\frac{5}{8}$ in. dia. Present production capacity, 1000 converters per wk; converters in lots of 5000, $6.28 each; clutches in lots of 5000, $3.13. **Hoover Transmission Co., Inc., Green River Rd., Williamstown, Mass.**

Circle 11, Reader Service Card



Individual voltage regulators . . .
for control systems are incorporated in major electronic sub-assemblies, eliminating need for expensive, highly sensitive central power supply. This arrangement is said to assure maximum permissible isolation of sub-units and to make it possible to avoid long dc power supply lines. Voltage regulators are based on plug-in printed circuit boards and can be built to provide any output voltage from 150 to 300 v, from a range of inputs. Price and delivery information not made available. **Cubic Corp., 5575 Kearny Villa Rd., San Diego, Calif.**

Circle 12, Reader Service Card

Displays 2 symbols per sec . . .

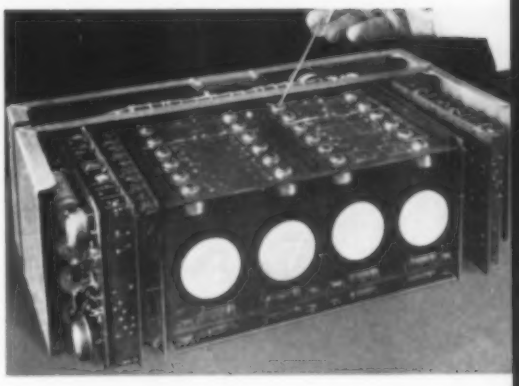
and requires 0.028 amp only for signal pulse. Holds position, without power, until next pulse. Weighs ¼ oz, is bearing-mounted and may be stacked. 1 to 10 pieces, $50 each; 100 or more, $35 each. Small quantities delivered in 30 days. **Patwin Div., Patent Button Co., Waterbury 20, Conn.**

Circle 13, Reader Service Card

Dissimilar metals are joined . . .

by a brazing technique that takes advantage of light weight and high heat transfer characteristics of aluminum alloys and combines them with desirable characteristics of other metals, such as stainless steel. Bond is gas- and liquid-tight; is resistant to thermal shocks from —320 F to more than 400 F. Bond strength is greater in tension than that of the parent aluminum at both normal and extreme temperatures. Brazing is accomplished in a closely controlled furnace at about 1100 F. **South Wind Div., Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago 14.**

Circle 15, Reader Service Card



Electronic digital display . . .

has no moving parts and permits operator to read exact numbers rather than a scale for such readouts as pressure, temperature, speed, and other numerical factors. It has printed circuit plug-in panels with passive components. 2-in. cathode ray tubes provide readout for two, four or six digits, with the benefits of wide-angle viewing, power consumption of less than ¼ amp, and fast response. Utilizes 115 v, 60 cps, single phase 50 va input. Unit weighs less than 23 lb and measures 17¼ x 13 x 6 in. in cabinet model. Operates in temperatures of —58 to 302 F. Available in decimal or binary circuits for contact closure, low voltage dc input or memory pulse input. Can be used in conjunction with decade counters, elapsed time indicators, events-per-unit-time meter, frequency meters, analog-to-digital converters, punched card and taped readers and digital voltmeters. Cost ranges from $575 to $875, depending on model. **Hoffman Electronics Corp., Semiconductor Div., 930 Pitner Ave., Evanston, Ill.**

Circle 18, Reader Service Card

Take-up connectors . . .

compensate during assembly or installation for accumulated tolerances in ducting systems. Units can be extended or shortened by means of a threaded adjustment to match two fixed points.

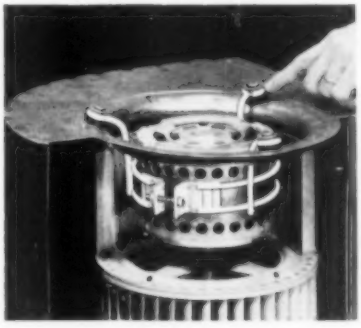
Two types of take-ups are produced: braided bellows and external sleeve types. The 2-in. braided unit weighs 12 oz and operates under pressure of 250 psig from —65 F to 1000 F. Delivery in 3 to 4 wk. **Arrowhead Products, Div. Federal-Mogul-Bower Bearings, Inc., 2330 Curry St., Long Beach, Calif.**

Circle 16, Reader Service Card

Extrudes rubber over metal . . .

in a continuous, watertight film up to ⅛-in. thick. Process is said to have application where atmospheric or moisture seals, such as weatherstripping, can be incorporated into structural members by means of extruded coatings. Machines will handle metal forms up to 4½ in. wide x 1 in. high cross-sections and up to 16-ft lengths. Aluminum bus bars are run through the rubber extruders in straight lengths. Coating thickness is controlled by extrusion die design and feed pressures. Coverings can be butyl, GRS, Hycar, neoprene and rubber in black and colors. **Geauga Industries Co., Middlefield, Ohio.**

Circle 14, Reader Service Card



Encircling motor mount . . .

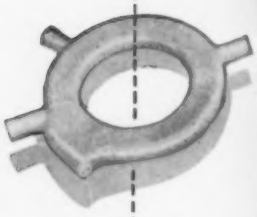
is of single-unit construction that eliminates storage and assembly of many parts. The welded-wire squirrel cage blower motor mount is said to reduce noise level of motor because of natural resilience of wire. Price is 35¢ to 65¢ each, depending on quantity. 2 to 4-wk delivery. Variations on this mount are also available. **E. H. Titchener & Co., 67 Clinton St., Binghamton, N. Y.**

Circle 17, Reader Service Card

Counts by weight . . .

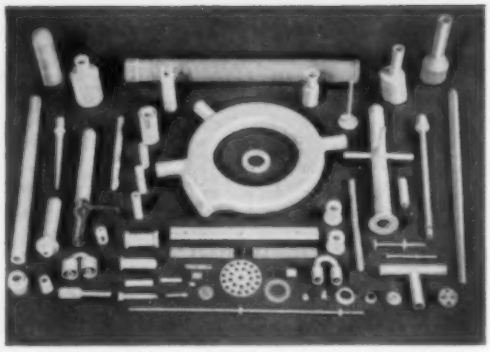
giving visual indication and/or actuation of associated control system when batch weight or count has been reached. As little as 0.004 oz produces pointer deflection greater than ¼ in. Counting speed and sensitivity are adjustable. Indicator is $800. Based on electronic weighing cell, obtainable with either flat platform for holding containers or with tilt pan, priced at $610 and $685, respectively. Delivery on the complete unit in 2 to 3 wk. **Avion Div., ACF Industries, Inc., 11 Park Pl., Paramus, N. J.**

Circle19, Reader Service Card



may be your ANSWER

McDANEL CERAMICS



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(Test count-life over 70 million)

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First high-speed electrically actuated counters with added advantage of electric reset. Clean-cut, legible 3/16" figures, white on black. Ideal for all high-speed electric counting applications — accurate at high, low or intermediate speeds.

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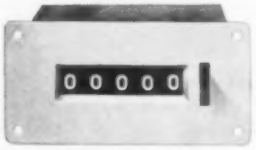
ALASKA GRAY AND SEAL BROWN



Compact, with great rigidity — entirely enclosed against dust and moisture. Base or panel mount. Speeds to 1500 C.P.M.

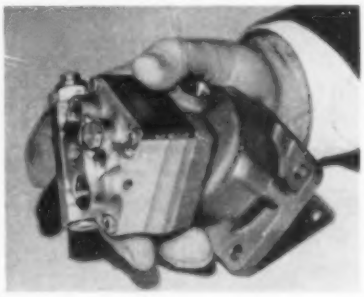
PRODUCTIMETERS SINCE 1879 *Count Everything*

SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

Extra-thin stampings . . .

in thicknesses up to 0.006 in. are available in any size, shape or metal. Parts are said to be free of distortion or burrs where long, narrow slots, adjacent narrow and wide sections, or other intricate shapes are involved. Tooling will run $50 to $200, depending on size and complexity of part. Unit part prices will depend on quantity and specifications. Normally, manufacturer claims that prices will be competitive with or better than ordinary stampings. Delivery, if material is available, can begin within two to three days of completion of tooling. **Techniques, 52 Jackson Ave., Hackensack, N. J.**

Circle 20, Reader Service Card



Variable displacement pump . . .

weighing 2.4 lb is capable of flow up to 9.7 gpm at 24,000 rpm. Max recommended speeds are 12,000 rpm for aircraft applications and 18,000 rpm for missile use. It is capable of 24,000 rpm for intermittent duty cycles. At this speed and 3000 psi, pump power output approximates 17 hp. Reliability and response characteristics are said to equal or exceed those of normal size hydraulic pumps now in use for variable displacement airborne applications. Number of parts have been reduced and external sealing elements have been minimized. Pump is adaptable to a broad range of control methods such as flat or differential cutoff, constant power, dual range, electrically depressurized and load-sensitive systems. **Vickers Inc., Detroit 32.**

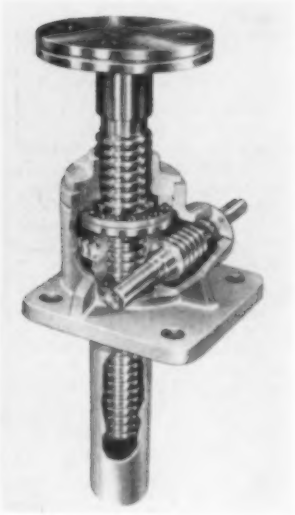
Circle 21, Reader Service Card

Thermosetting acrylic finish . . .

exhibits color retention when subjected to light and heat and is said to outperform conventional finishes by its resistance to soaps and detergents. A few blisters may appear, but there is no loss in film hardness and a minimum loss in gloss. It is reported to be surpassed in heat resistance only by considerably more expensive silicone enamels. Provides good corrosion re-

sistance, gloss and build, resistance to abrasion and to staining by foods, drugs and household chemicals. Sprays freely without cobwebbing in standard spray equipment. Baking schedule is 350 F for 30 min. **Interchemical Corp., Finishes Div., P.O. Box 659, Newark, N. J.**

Circle 22, Reader Service Card



Worm gear jacks . . .

in capacities of 2, 5, 10, 15, 20, 25, 50 and 100 tons will hold heavy loads in position indefinitely without creep. Jacks require no adjustment. All eight models have a uniform rate of raise which permits jacks of varying capacities to be operated in unison on unevenly distributed loads. Can be obtained with height adjustment capacity as much as 24 in. Used on materials handling equipment, work tables. **Duff-Norton Co., P. O. Box 1889, Pittsburgh 30, Penna.**

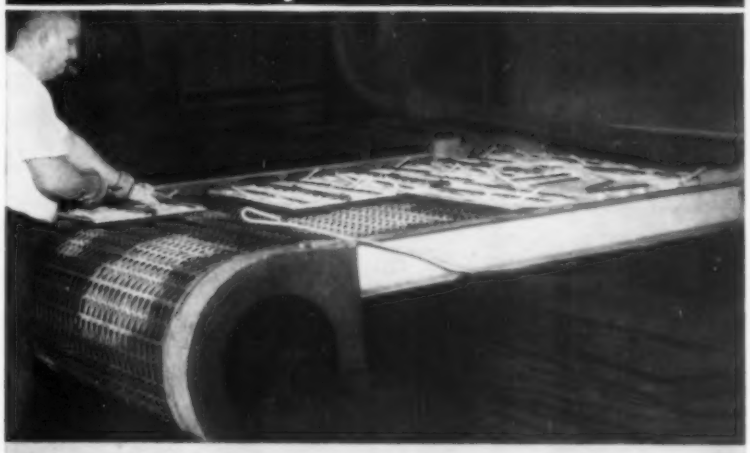
Circle 23, Reader Service Card

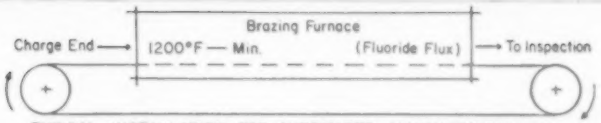
High-torque drive . . .

for 12-v use consists of a series-wound dc motor integral with a 30:1 worm gear reducer. Motor has dual field winding to allow simple reversing and incorporates a motor shaft brake to prevent coasting or overtravel. Applicable to mobile equipment, for hoisting, actuating or positioning use, trucks, buses and boats. **Ven Corp., 2828 Newell St., Los Angeles 39.**

Circle 24, Reader Service Card

Cambridge WOVEN WIRE BELTS





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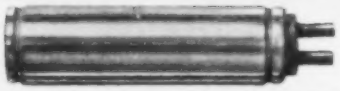

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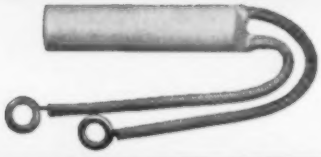

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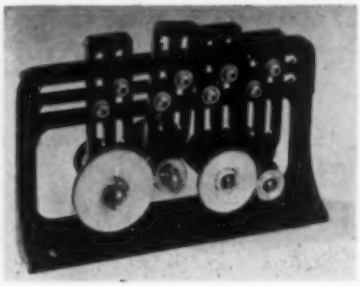
SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .



Adjustable hanger . . .

permits assembly of complete gear train as an integral unit, which means that large reductions, having several meshes, can be independently set up prior to mounting on servo breadboard plates. Bores are set in accordance with recommended bearing mounting specification for precision fits. Flexibility allows for low backlash adjustment. Rigid aluminum alloy castings are machined for squareness. A maximum of six vertical adjustable hangers can be mounted on main frame. Mounting centers of assembly are spaced for use with most existing breadboard plates. **Sterling Precision Corp., Instrument Div., 17 Matinecock Ave., Port Washington, N. Y.**

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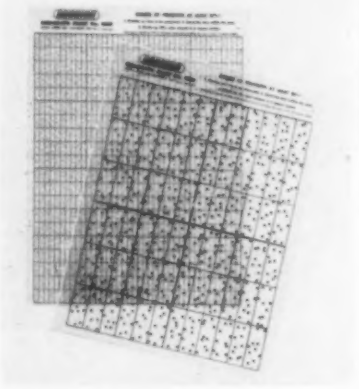

Measures irregular areas . . .

by placing a transparent polyester film printed with a pattern of grids and dots over area to be measured. Dots falling within the area to be measured are counted and then divided by a factor printed on overlay. Answer is given in square inches. Overlays are available in sets of three, one chart for each of three predetermined degrees of accuracy, 85, 90 and 97%. Film does not tear, distort or discolor. Grid lines and dots are protected by varnish. **Charles Bruning Co., Inc., 1800 Central Rd., Mount Prospect, Ill.**

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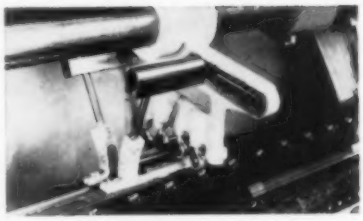

It is essential that the guide bars on the Kidde Knitter move laterally, both smoothly and freely. Here is an example of how

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Assembly is simple, yet alignment of bars is positive.

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air circuitry:

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The new role that pneumatic control can play in industrial operations demands a new way of thinking about air control. It demands a new way to describe control by air—a new name that suggests some of its limitless control possibilities. That's why Westinghouse Air Brake Company is now using the term "air circuitry" to describe the application of air control to automation.

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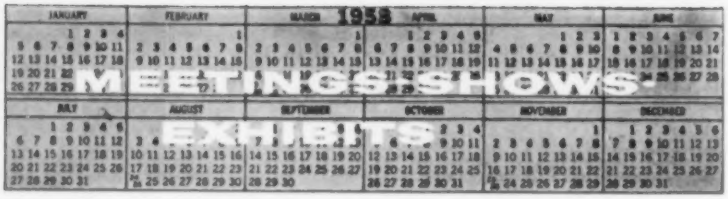
This extreme simplicity brings with it other important "pluses" for air circuitry. The simple equipment is unusually reliable—there are few moving parts to wear out or get out of adjustment. The devices are sturdy and durable. They require very little maintenance. What maintenance there is can be handled without the services of highly trained technicians.

Above all, remember: no means of control is as *safe* as air.

Air circuitry can help you simplify your control problems. It can help you get accurate answers to your automation problems on any industrial machine . . . in any industrial process. And Westinghouse Air Brake Company can help you with the engineering of a suitable system. Westinghouse has been in the control engineering business for 80 years now. It has been at the forefront of the development and improvement of air control equipment and its applications.

For more information on Westinghouse Air Circuitry—how it has helped other companies, how it can help you—write for your copy of "Basic Pneumatic Control," or call our nearest sales office.

WESTINGHOUSE AIR BRAKE COMPANY, INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PA.



APR.

21-23 **Powder Metallurgy Show and Meeting,** sponsored by Metal Power Association, Sherator Hotel, Philadelphia. Sessions cover production techniques, applications and properties of powder metallurgy parts. For information contact Harold Schor Associates, 114 E. 40th St., NYC.

20-24 **Scientific Apparatus Makers Association,** 40th annual meeting, El Mirador Hotel, Palm Springs, Calif. For information contact the Association, 20 N. Wacker Drive, Chicago 6.

21-23 **Building Research Institute,** Seventh annual meeting Shoreham Hotel, Washington, D. C. Sessions will cover design problems of solar heating, new building materials and other technical problems. For information contact the Institute, 2101 Constitution Ave., Washington 25.

22-24 **Electronic Components Conference,** Ambassador Hotel, Los Angeles, Calif. Technical sessions will cover solid state devices, component reliability, electron tubes and materials. For information contact George Norman, PO box 66507, 12870 Panama St., Los Angeles, Calif.

24-25 **ASME–Society for Advancement of Management,** joint Engineering Management Conference, Hotel Statler, NYC. Sessions cover problems in work sampling, unions and industrial engineering, measurement of indirect and clerical labor and how to measure industrial engineering performance. For information contact ASME, 29 W. 39th St., NYC.

29-30 **Seminar on the New American Drawing Standard,** University of Ill. and local engineering societies. For information contact Robert Newton, 725 S. Wright, Champaign, Ill.

28-May 10 **Industrial Packaging Training Conf.,** Industrial Management Center, Lake Placid Club. Topics on program include analysis of shock and vibration, packaging machinery and conveyors, standard costs for packaging, and solving specific packaging problems. For information contact James Bright, 56 B Robbins Road, Lexington, Mass.

30-May 3 **National Screw Machine Products Assn.,** 25th anniversary meeting, Drake Hotel, Chicago. Sessions include seminars on chief executive's job in a small shop, factory manager's job in small shops, planning for profits, and controls for factory and financial efficiency. For information contact the Association, 2860 E. 130th St., Cleveland.

MAY

1-8 **American Society of Tool Engineers,** Annual Meeting and Tool Show, Philadelphia Convention Center, Philadelphia, Penna. For information contact Richard Gebers, 10700 Puritan, Detroit 38, Mich.

2 **Conference for Engineers and Architects,** sponsored by Ohio State Univ., Sessions will cover satellites and space craft, nuclear engineering, computers and automatic controls. For information contact Assoc. Dean Harold A. Bolz, Ohio State Univ., Columbus 10, Ohio.

5-7 **AIEE, Great Lakes District Meeting,** Michigan State Univ., Lansing. Sessions range from guided missiles and nuclear engineering in Russia to automobile lighting and railroad communications. For information contact Raymond C. Mayer & Associates, 36 W. 46th St., NYC.

7-17 **World Trade Fair,** Second annual fair at New York Coliseum. More than 60 nations are expected to present 3000 exhibits.

7-17 **Mechanical Handling Exhibition** and Materials Handling Convention, Earls Court, London. Exhibition will include products of foreign as well as British manufacturers. For information contact Derek Page, Associated Iliffe Press, Dorset House, Stamford St., London SE 1.

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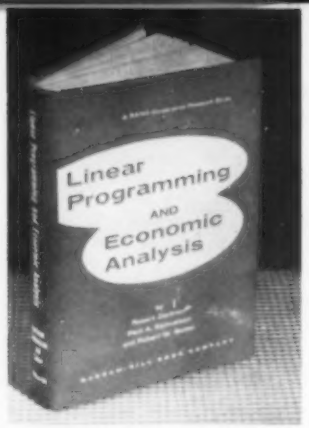

NEW LITERATURE

Linear Programming and Economic Analysis

ROBERT DORFMAN, Harvard U. PAUL A. SAMUELSON, ROBERT M. SOLOW, *Massachusetts Institute of Technology. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36.* 6¼x9¼, 527 *pp*, $10.

There are three outstanding methods of analyzing variables in an economic (or military) problem to obtain the maximum—or minimum—gain. The three: linear programming, input-output analysis, game theory.

The theory of games states that there is a close analogy between parlor games of skill and conflict situations in economic, political, and military life. In any of these situations there are a number of participants with incompatible objectives, and the extent to which each participant attains his objective depends upon what all the participants do. The problem faced by each participant is to lay his plans so as to take account of the actions of his opponents, each of whom, is laying his own plans to take account of the other participants' action.

The theory shows that under certain assumptions, each participant can act to guarantee himself at least a certain minimum gain (or maximum loss). When each participant acts to secure his minimum guaranteed return, then he prevents his opponents from attaining any more than their minimum guaranteed gains. Thus the minimum gains become the actual gains.

Input-output analysis is based on the idea that a very considerable proportion of the effort of a modern economy is devoted to the production of intermediate goods, and the output of intermediate goods is closely linked to the output of final products. A change in the output of any final product (say automobiles) implies changes in the outputs of the intermediate goods (copper, glass, steel, etc., including automobiles) used in producing that final product. The theory has been employed to compute employment levels in the various sectors and, hence, total employment consequent upon a presumed pattern of final demand.

Linear programming was developed by George B. Dantzig in 1947 as a technique for planning the diversified activities of the US Air Force. In any operating period the Air Force has certain goals to achieve, and its various activities of procurement, recruitment, maintenance, training, etc., are intended to serve those goals. The relationship between goals and activities in an Air Force plan is analogous to input-output analysis. However, in Air Force planning, or in planning for any similar organization, there are generally found to be several different plans that fulfill the goals. Thus a criterion is needed for deciding which of these satisfactory plans is best, and a procedure is to find best plant.

The mathematics in this text on linear programming is not difficult. For the most part only the ability to solve a series of simultaneous equations is necessary. A computer will help, but the appendix includes the algebra of matrices for working out simultaneous equations by hand.—NC

Card Index to Scientific, Engineering Periodicals

PRODUCT ENGINEERING is one of the 510 periodicals that have long been indexed by the US Naval Research Laboratory. This index is now becoming available in book form. The original index cards are reproduced on 10x14-in. pages, 21 cards per page. Available only to those subscribing in advance of printing, which is to start this summer. *Micro-photography Co., 97 Oliver St., Boston.*

DESIGN FACILITIES—Brochure, 16 pp. Discusses facilities for developmental product research, product design, production processes, machinery and tooling. Profusely illustrated with pictures of personnel, products and manufacturing equipment. Centerline, Inc., 29700 Euclid Ave., Wickliffe, Ohio.

Circle 1, Reader Service Card

AIRCRAFT, MISSILE ELECTRICAL SYSTEM—Bulletin GET12743, 8 pp. Describes new system, giving details on operation, mechanical design, electrical performance, system advantages. Photos, circuit diagrams, charts, graphs and oscillograms included. General Electric Co., Schenectady 5, N. Y.

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AIR-DRIVEN ELECTRICAL POWER SYSTEM—Bulletin GET-2743, 8 pp. is a technical report on design and development of an air-turbine-drive ac electrical power system for airborne application. Information on turbonator concept, design configuration and developmental testing is included. Supplemented by photos, cutaway and schematic drawings, charts. General Electric Co., Schenectady 5, N. Y.

Circle 3, Reader Service Card

GRAIN-ORIENTED SELENIUM RECTIFIERS—Bulletin EPD 3116-1, 48 pp. Provides information on construction details, performance characteristics, application suggestions, installation instructions, dimensions. Vickers, Inc., 1815 Locust St., St. Louis 3, Mo.

Circle 4, Reader Service Card

SILICON RECTIFIERS—Handbook 67, 40 pp. This revised edition covers some basic concepts of design and application. Theory of operation, characteristics and conventional circuits are considered. The handbook also serves as a catalog of the firm's line of silicon restifiers. Sarkes Tarzian, Inc., 415 N. College Ave., Bloomington, Ind.

Circle 5, Reader Service Card

TOOL STEELS—Three technical manuals discuss tool steels used in industrial production. "Tool Steels for Forging Operations," 12 pp, treats use of various grades of tools steels for hot forging. Illustrations and charts present data on topics such as heat treatment recommended. "Tool Steels for Die Casting Process," 12 pp, contains requirements for all die casting tools, together with data on quenching, tempering, nitriding and influence of lubrication. "Tool Steels for the Hot Extrusion Process," 8 pp, has brief discussion of process. Aluminum, magnesium, copper, copper alloys and steel extrusion processes are described together with recommended tools steels for better results. Crucible Steel Co. of America, Oliver Bldg., Pittsburgh 22.

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Publisher's Postscript...

Reading— the High-dividend Investment

The engineering graduate today is exposed to far greater opportunities for personal development than his father ever dreamed about when he graduated from college 25 or 30 years ago. In those days we led a relatively simple life. Salaries were low. Hours were long. Taxes were "peanuts" measured by present standards. Radio was a new fad; television was unheard of. Electronics was a word few people understood, even engineers.

Just think back 30 years to 1928 (if you were practicing your profession at that time) and compare the progress made since. Outside of the staple food commodities, there are few things we use in our daily lives that could have been purchased then.

One might naturally wonder why we have made such spectacular progress in the last 30 years—far more than we made in centuries before. And one might also wonder why we have been able to develop our present high standard of living so far above that of any other nation in the world.

One of the principal contributing factors—one that seldom gets the credit for its basic contributions to our better way of life—is the engineering and business press of America. Not only has engineering journalism substantially contributed to our progress, but engineers who are doing things, and the companies for whom they work, have been willing and anxious through the printed page to share their discoveries with others in their profession.

Week after week, month after month, the engineering and business press is loaded with new ideas, presented in clear and factual form. Since the late twenties, literally hundreds of new business publications have come into being—many highly specialized, so that today the man who wants to keep abreast of progress—in almost any field—can get the results of the best thinking and reporting of hundreds of engineering and business-trained editors by merely reading the technical or business publications that are edited for his specific interests.

But to keep up to date today, the engineer must read. A prominent educator recently said that any engineer who does not read becomes "obsolete" in seven years. That's a reasonable statement—it reflects how fast we are moving.

You may not realize it, but when you read a publication like this, you are getting the best thinking and reporting of a corps of experienced engineering editors who not only comb this country for what's new in the field of product design, research and development, but also most of the foreign lands where things are happening.

It probably would cost anyone close to a half a million dollars a year to match the information service any one of the leading business publications makes available to you week after week.

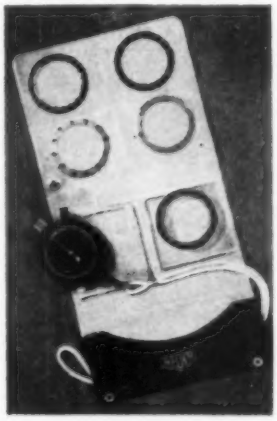
But do not fool yourself, the service is **not** free—it takes a substantial investment of your reading time to be of any real value. Unless you get into the habit of devoting a certain amount of time each week to reading, you'll quickly fall behind the parade—and soon be "obsolete." You have to know why, what, when, where and who. You can read yourself to success.—AH

FYI For Your Information (personal)

To make your mark

A new type of "lead," a graphite-based composition with a far higher melting point than ordinary grease-pencil leads, is the key to a new write-on-anything pencil developed by Richard Best Pencil Co. It can be sharpened in a regular machine without clogging the cutters, will write legibly on paper, and makes a durable mark on glass, plastics, and rubber—almost anything except highly polished chrome. Pencils come neatly packaged—12 to a box, encased in cellophane with a zip-tape opener, and sanitized by ultraviolet rays. Price is $1.75 a box, but a sample may be obtained by PE readers without charge. Address H. M. Heath, (FYI) Richard Best Pencil Co., Springfield, N. J.

Timed to suit



Interchangeable dials make this timer a six-in-one stopwatch that can be used for everything from yacht-racing to basketball. A lock-out reset button and a good-sized start-stop-wind stem, plus clear, good-sized numbers make it easy to use; and the special case, plus a nylon cord lanyard, make it easy to handle. Called the *Ring-Master*, it's priced at $75 at Abercrombie & Fitch in New York, Chicago, and San Francisco. Dial dia is 2 in. The idea of interchangeable dials certainly isn't new; but this one seems to cover all the bases—the "bases" in this case being polo, hockey, football, and sportcar racing in addition to the two noted above.

Moon-talkie

Want to hear a satellite? You can—for just $1100. Motorola has modified its well-known "Handie-Talkie" telephone to produce a sensitive portable telemetering receiver that will receive on the standard US-IGY satellite frequencies, maintain phase-lock to a carrier signal that is more than 20 db below the receiver noise level, and can indicate relative signal frequency plus Doppler shift. The unit weighs 10 lb, is less than 12 in. long. It was, of course, designed for government use, but may be had commercially. (For other satellite-tracking equipment, and advice on pitfalls to avoid, see *FYI* column, *PE*—Feb. 10, '58.)

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PRODUCT ENGINEERING
330 WEST 42ND STREET
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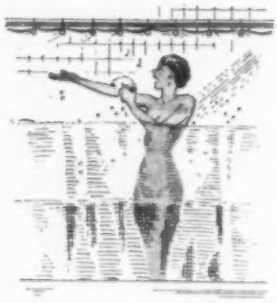
WHY DON'T THEY RESEARCH and DEVELOP...

. . . a phosphorescent solution to be mixed in concrete asphalt or blacktop road materials. A highway with a soft glow would considerably ease night driving —with clearly marked road edges, intersections, obstructions and the like.

—B. E. Williams

. . . an electrically heated steering wheel for automobiles? The system would warm the wheel until the car's space heater raised the car interior temperature to comfort levels. At this point a thermostat could cut off current to the resistance wire imbedded in the wheel. A small access hole would permit adjustment of thermostat operating temperature. —E. Vehslage



. . . a shower curtain with transparent upper third and standard opaque, decorated material for the rest. The two parts could be sewed, or heatsealed in a waterproof joint. A parent could shower and keep an eye on young children—and when the youngsters get playful in the controlled "rain," mothers could take a quick look without getting a wet head. —E. H. Meitzler

. . . a very sticky fluid to improve the friction coefficient between car wheels and wet or icy roads. It should be cheap and noncorrosive. By controlling a valve from inside the car the fluid might be permitted to flow over the tire when needed.

—M. O. Young

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

WARNER

electric motion control FACTS

Electric Slip Clutch Controls Reel Tension Automatically

Here are two ideas you might use to modernize machinery.

A manufacturer wanted to prevent pile-up at the let-off end and maintain constant tension on the take-up reel while processing conveyor belting on a 25 ft. platten press. Two features of Warner electric brakes and clutches—stepless torque modulation and electric operation—provided the simple answer to both problems.

First, an electric clutch was installed on the input shaft of the four-speed transmission for the take-up reel. (Fig. 1). Torque was adjusted so it slipped constantly, keeping tension on the roll and providing a soft, gradual pull-off.

Torque adjustable to reel speed

Since the take-up reel builds up in diameter during the winding cycle, it was necessary to vary reel speed and adjust clutch torque accordingly. A potentiometer was installed in the electrical circuit to increase or decrease current flow to the clutch and vary the amount of electromagnetic pull.

When starting up, the operator sets the transmission in first gear—its highest ratio. As the roll gets larger, he shifts to the next speed and adjusts the potentiometer, increasing clutch torque and reducing slippage. When the transmission reaches fourth gear, the reel is at its lowest speed and the clutch at its highest torque.

Fig. 1—Warner electric slip-duty clutch is mounted on input shaft of four-speed transmission. Power is transmitted when the clutch magnet is energized and attracts the armature.

Electric brake controls belt dip

The second problem was to prevent pile-up at the opposite end of the press. A Warner electric brake was installed on the jackshaft of the let-off reel. Intermittent engagement of the brake, actuated when the belt dips low enough to contact a micro-switch button, keeps slack under control. It's a simple way to prevent trouble when pulling material off a reel.

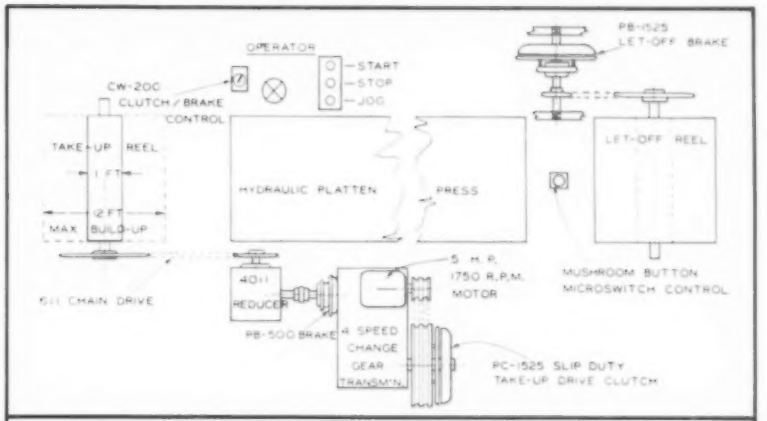


Fig. 2—Automatic tension control on power drive of take-up reel and intermittent braking of let-off reel make possible constant, equalized tension of material being processed. Mushroom button prevents excessive build-up at the let-off end.

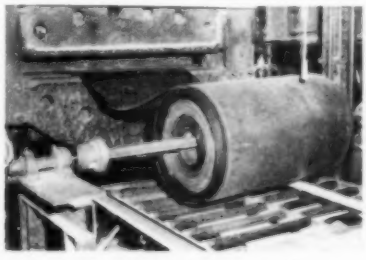
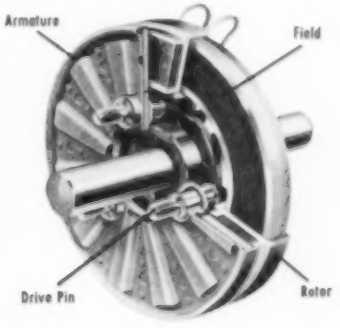


Fig. 3—72 in. conveyor belt press produces continuous rolls weighing up to nine tons.

New stationary-field clutches end slip-ring problems

Warner's new stationary-field electric clutch has integral leads to the field coil. Design is simple—only one stationary and two rotating members. The field is mounted to the machine frame, providing a permanent assembly of the electrical part. After extended usage, friction surfaces can be replaced without disturbing the electrical connections. Analysis of your machine drives, with electric brakes and clutches in mind, might reduce operating and maintenance costs appreciably.

Warner units do things other brakes and clutches can't do—so the opportunities to modernize are many!



Want more IDEAS?

Send for factual application sheets showing how to modernize by installing electric brakes and clutches on all types of machines, making them more productive, easier to control, simpler to maintain.

Industrial Products Division
Warner Electric Brake & Clutch Co.
Beloit, Wisconsin

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WHATEVER THE APPLICATION

you can improve your product with

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PRECISION FINISHED PARTS

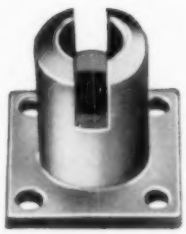
GRAMIX precision finished parts are improving products in virtually every branch of industry. A pump manufacturer, for instance, may specify a gasoline pump rotor made of GRAMIX and gain a number of advantages.

To begin with, the alloys are carefully blended to meet his individual requirements. The GRAMIX parts are then die-pressed to exact shape, sintered under rigid control and finished to tolerances as close as .0005". (This process, of course, costs far less than machining, forging or casting.) The manufacturer can expect the GRAMIX gasoline pump rotor to do a better job because *all* GRAMIX parts are precision engineered and precision controlled from alloying to finishing.

No matter what the application may be, GRAMIX parts fit specifications exactly. Parts may be impregnated with oil . . . to insure a longer life and a quieter operation: if specified, the GRAMIX parts may be coined and work hardened, even prepared for plating.

The rotor is only one of thousands of applications in which GRAMIX precision parts have proved to be ideal. Just a few of them are shown here, so consider the components of your products . . . there may be several that could be improved . . . with GRAMIX! Products of powder metallurgy you can rely on.

Hardened steel drive sprocket for lawnmower



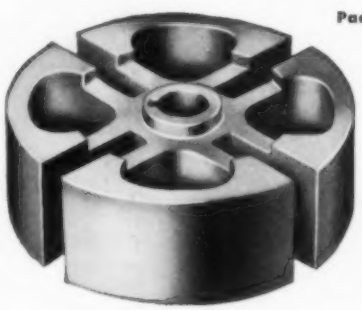
Iron switch control

Rotor for gasoline pump

Packing gland follower used in hydraulic system

Write today for factual Engineering Bulletin No. 21 . . . we'll send your copy.

PM PM MEMBER



Bronze rotor in high speed fueling unit

X-245-1

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